A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1936.

GENERAL PHYSICS.

ADSORPTION.

✱4427. Adsorption of Gases and Gas Mixtures on Charcoal. E. Husung. *Zeits. f. techn. Physik*, 17. 9. *pp.* 289–301, 1936.—Apparatus for adsorption measurements and for analysis of gas mixtures avoiding the use of taps is described. For O_2 on charcoal at room-temperature a previously unobserved saturation point is recorded. Adsorption of oxygen up to this point is an irreversible process. The isotherms for − 78° and − 183° are quite different. The adsorption of A is reversible. Adsorption of A − N_2 mixtures confirms Dalton's law at + 22° and − 78°, but does not do so at − 183°. Preliminary saturation of the charcoal with O_2 diminishes the adsorption of both individual gases and of the mixture, but the relative adsorption of N_2 is increased. The results are discussed in the light of a theory by Polanyi. Technically, they show that O_2 can conveniently be removed from other gases at room-temperatures, whilst A and N_2 are best separated at temperatures between − 78° and − 183°. Previous degassing of the charcoal at high temperatures is necessary for O_2 adsorption, whereas simple pumping suffices for N_2 and A. C. B. A.

4428. Sorption Equilibria of Methane, Ethane and Propane on Charcoal. E. Weingaertner. *Zeits. f. Elektrochem.* 42. *pp.* 599–606, *Aug.*, 1936.—Sorption data are given in the region in which the linear Langmuir isotherm normally holds. Deviations from linearity below the critical temperature are ascribed to the formation of condensed layers. A new general equation for the isochores is given based upon the observation that for these systems the ratio of molar heat of adsorption (above the critical temperature) to the critical temperature is constant. L. V. C.

4429. Adsorption on Agate Powders in Relation to Artificial Coloration of Agates. L. Hock and O. Becker. *Kolloid-Beihefte*, 44. *pp.* 238–253, *Aug.*, 1936.—Three agates, reduced to the same size-class but differing in their ease of coloration by the standard procedure of heating at 350° C. following prolonged immersion in solutions, *e.g.*, of $Fe(NO_3)_2$, were subjected to a variety of cleansing treatments and their adsorption isotherms for water vapour determined. The agate most susceptible of coloration adsorbed most water vapour, though all came closely into line after treatment with caustic alkali. Adsorption was slightly less after heating at 350°—an effect ascribed to sintering—but was not affected by presence of metallic oxides from the pickling solution. The heat of adsorption of water vapour was some 10 % higher than the latent heat of evaporation of water and was of the same order for all three agates. Differences between the three were ascribed to differences in the ratio active/total surface, as confirmed by tests on their adsorption of methylene blue from its aqueous solution. This ratio is reduced in the course of milling owing to repeated cleavage. L. V. C.

4430. Kinetics and Heat of Adsorption of Ethylene by Platinum. E. B. Maxted and C. H. Moon. *Faraday Soc., Trans.* 32. *pp.* 1375–1381, *Sept.*, 1936.—The secondary adsorption of C_2H_4 by Pt black, namely the slow process which takes place subsequently to the almost immediate primary adsorption, follows the relationship previously observed by Ward for H_2 on Cu, according to which the ratio of the volume adsorbed to the square root of the time is a constant. It consequently also agrees with Bangham and Burt's general equation, which involves a linear relationship between log v and log t. Since the normal vacuum calorimetric method is inapplicable to C_2H_4, on account of its small adsorption at low pressures, a calorimetric method involving adsorption at atmospheric pressure is developed for the measurement of the adsorption heat. This is tested for H_2 diluted with an inert gas, and is found to give an adsorption heat of approximately the same value as that previously determined in the normal way. On applying the method to C_2H_4 a molecular heat of adsorption of about 9 k. cal. is observed. It is necessary in all cases, both for the measurement of the kinetics and of the heat of adsorption, to subject the Pt to preliminary treatment to remove residual adsorbed gases other than C_2H_4. AUTHORS.

4431. Migration of Cæsium on Tungstic Oxide. L. Frank. *Faraday Soc., Trans.* 32. *pp.* 1403–1414, *Sept.*, 1936.—The adsorption of thin films of Cs on a surface of tungstic oxide is studied by a photoelectric method for the temperature range 125° K. to 400° K. The phenomena occurring are described qualitatively by the assumption that the Cs atoms migrate into the mass of the oxide. Values for the activation energy connected with this migration are derived. AUTHOR.

4432. Adsorption of Gases by Lead Chloride at Low Pressures. F. Durau and J. Reckers. *Zeits. f. Physik*, 101. 11–12. *pp.* 755–768, 1936.—The pure gases N_2, H_2, CO, N_2O, CH_4, C_2H_6, C_3H_8, C_2H_2 and CH_4 were adsorbed by lead chloride balls whose surfaces were measured geometrically and also determined by the radioactive method of Paneth and Vorwerk. The results of the investigation support the conception of the monomolecular character of the adsorption. Within the pressure range investigated, a proportionality was found between pressure and adsorbed gas. From the propane data, the heat of absorption, calculated from the formula $a/n = o.d.e^{\varphi/RT}$, is greater than the heat of evaporation, while the thickness of the adsorption layer based on the radioactively determined surface has an appreciably smaller value than the molecular diameter [See following Abstract.] H. H. Ho.

4433. Adsorption of C_6H_6, C_6H_{14} and CH_3COCH_3 by Lead Chloride at Known Surfaces. F. Durau and G. Tschoepe. *Zeits. f. Physik*, 102. 1–2. *pp.* 67–101, 1936.—Traces of water in the adsorptives appreciably changed the course of the adsorption isotherms. While by the use of perfectly dry benzene and hexane, straight lines were obtained, definite curves were given by the slightly moist adsorptives, even when they had been vacuum distilled. The experimental results show most forcibly that adsorption measurements should only be undertaken with surfaces free from objection and with clean absorptives. The heats of adsorption are compared with the heats of evaporation and the errors of measurement of the thickness of the adsorption zone investigated. The adsorption isotherms for C_6H_6 and C_6H_{14} may be derived from the equation $ap_s/n = F$, where p_s is the saturation pressure. [See preceding Abstract.]

H. H. Ho.

See also Abstracts 4508, 4658.

ATOMIC AND MOLECULAR STRUCTURE.

4434. Simple Model of the Nucleus. K. Bechert. *Zeits. f. Physik*, 101. 11–12. *pp.* 721–731, 1936.—It is assumed that the constituents of the nucleus have no other interaction than the Coulomb interaction between the protons and that each particle moves in a field of potential energy which has the same value for all particles (*i.e.*, the same for neutrons and protons) inside the nucleus and vanishes outside. Application of Fermi statistics is made to this model, with the additional condition that the particle of highest kinetic energy has just the binding energy zero. The equations are soluble only if the number of protons and the number of neutrons satisfy a certain relation which is given numerically and graphically. The resulting relation between atomic number and atomic weight agrees well with the empirical values. R. P.

4435. Attempt to Calculate the Number of Energy Levels of a Heavy Nucleus. H. A. Bethe. *Phys. Rev.* 50. *pp.* 332–341, *Aug.* 15, 1936.—Available evidence indicates that heavy nuclei possess an enormous number of energy levels, very closely spaced for a highly excited nucleus. A rough statistical method is developed for calculating this spacing. Assuming that the individual nuclear particles move in a simple potential hole and that the energy of the complete nucleus is the sum of the energies of the individual particles, the " entropy " of a Fermi gas containing a given number of particles A and having a given excitation energy Q above the zero-point energy of the Fermi gas is calculated. This gives the total number of levels of the complete nucleus in a given energy interval irrespective of the angular momentum. The spacing of nuclear levels is found to depend on the product of the mass number A and excitation energy Q of the nucleus, and to be given roughly by $\triangle = 4 \cdot 1 \times 10^6 x^4 e^{-x} / (2I + 1)$ volts, where $x = (A\,Q)^{1}/2 \cdot 20$, Q being expressed in MV, and I being the nuclear spin. The spacing decreases rapidly with increasing atomic weight. For a given atomic weight, the spacing of the levels responsible for neutron capture is wider for capture leading to a radioactive nucleus than to a stable nucleus, in agreement with experiment. N. M. B.

4436. Relativity and Nuclear Forces. H. Margenau. *Phys. Rev.* 50. *pp.* 342–344, *Aug.* 15, 1936.—To obtain an estimate of the relativity correction in nuclear problems, the Klein-Gordon theory is applied to the common forms of interaction between the neutron and the proton. Because there is an appreciable region of space in which the zero-point energy is enormous, the relativity effect is larger than would be supposed by mere inspection of binding energies. For the deuteron, it amounts to several times the binding energy if the forces have a range around 10^{-13} cm. ; for ranges about 3×10^{13} cm. it decreases to a few per cent of the binding energy. The calculations were based on two types of assumed interactions : the rectangular potential hole and the error function potential. AUTHOR.

4437. Interaction of Light Nuclei. Part III. Binding Energies of He^4, He^5, Li^6, and of Nuclei of Type 4n. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 156*A*. *pp.* 634–654, *Sept.* 1, 1936.—The binding energies of the nuclei from H^2 to Li^6 inclusive have been investigated, assuming two-body forces of the same range between neutrons and protons, neutrons and neutrons, and protons and protons. The protons are treated effectively as different quantum states of the same particle which obeys the Pauli principle. He^4 then represents a closed shell and in He^5 the extra neutron goes into a 1*p* level with respect to the centre of mass of the system. He^5 is treated both as a five- and three-body system, the two methods giving the same general results. Allowing for various approximations, it is found that the observed masses of the nuclei considered are reasonably consistent if the range of interaction between the particles is between $1 \cdot 7$ and $2 \cdot 2 \times 10^{-13}$ cm. and the attraction between like particles between 0·2 and 0·3 of that between unlike particles. He^5 is shown to be probably unstable. For nuclei such as Li^7 and Be^8 the calculations indicate the necessity of explicit inclusion of some form of exchange force. The light nuclei of type $4n$ have also been investigated, assuming independence of the constituent α-particles. If the $\alpha - \alpha$ interaction is adjusted to give the observed masses of Be^8 and C^{12}, too large a binding energy is found for O^{16} and Ne^{20}. [For Part II see Abstract 4756 (1935).] AUTHORS.

4438. Transmutation of Sulphur by Th C′ α-Particles. C. J. Brasefield and E. Pollard. *Phys. Rev.* 50. *pp.* 296–301, *Aug.* 15, 1936. —The protons emitted from S under bombardment of Th C′ α-particles have been resolved into three groups corresponding to nuclear energy changes $-2 \cdot 4 \pm 0 \cdot 3$, $-2 \cdot 85 \pm 0 \cdot 3$ and $-3 \cdot 6 \pm 0 \cdot 3$ eMV. The first of these values, together with Bainbridge's value for the mass of Cl^{35}, has been used to deduce a value for the mass of S^{32}, namely, $31 \cdot 9812 \pm 0 \cdot 0016$. An excitation curve for the emission of protons has been plotted which obeys the Gamow penetration formula within the limits of error: from this formula the nuclear radius of S^{32} has been derived and has the value $5 \cdot 4 \pm 0 \cdot 3 \times 10^{-13}$ cm. AUTHORS.

4439. Disintegration of Be, B and C by Deuterons. T. W. Bonner and W. M. Brubaker. *Phys. Rev.* 50. *pp.* 308–314, *Aug.* 15, 1936.— Some previous work of the authors on the energy distributions of neutrons, liberated by the bombardment of certain light elements by 0·9 eMV deuterons, is continued and extended to Be, B and C. Disintegration equations are given for each element, and the more probable reactions are indicated. Experimental values of the disintegration energies are given in eMV. In cases where more than one value is obtained from a given reaction, the lower ones are attributed to excitation of the resulting nucleus. Agreement with previous results is, in general, quite good. A list of values of the disintegration masses of the light elements up to O^{16} is calculated from the disintegration reactions obtained by the authors and other investigators. G. O. B.

4440. Deuteron-Induced Radioactivities. J. J. Livingood. *Phys. Rev.* 50. *pp.* 425–434, *Sept.* 1, 1936.—Bombardment of several substances with 5 eMV deuterons produces the following radioactivities. Commercial copper decays with a half-life of 130 ± 10 d., emitting γ-rays and very slow electrons. Zn, Sb and Ru emit electrons with half lives of (97 ± 10 h., 25 ± 2 h., 12 ± 1 h., and 1 ± 0·3 h.), (50 ± 4 d., 68 ± 2 h., and 24 ± 2 h.), and (46 ± 3 d., 11 ± 2 d., 39 ± 1 h., and 4 ± 1 h.). Bi yields electrons of 5 d. half-life and α-particles which increase in number for 3 weeks and then remain practically constant. This is interpreted as the synthesis of RaE through the reaction ${}_{83}Bi^{209} + {}_{1}H^{2} \rightarrow {}_{83}Bi^{210}$, followed by its natural decay to Po and thence to Pb. [See following Abstract.] F. C. C.

4441. Deuteron-Induced Radioactivity in Tin. J. J. Livingood and G. Seaborg. *Phys. Rev.* 50. *pp.* 435–439, *Sept.* 1, 1936.—Tin has been bombarded with 5 eMV deuterons and chemically analysed for transmutation into radioactive In, Sn and Sb isotopes. The In fraction exhibits a strong electron emission of 26 ± 2 hours' half-life and an extremely weak activity of undetermined sign and with half-life probably several months. The Sn precipitate emits an intense electron group with half-life 28 ± 2 hours and a weak activity also of several months period. Two Sb isotopes are formed with half-lives of $13 \cdot 3 \pm 1$ hours and 112 ± 30 days. The former gives evidence of being a branching decay, both electrons and positrons being observed; the sign of the longer period has not been determined. Short period activities from bombarded tin are of 12 ± 2 minutes' and 45 ± 5 minutes' half-life. Absorption curves in Al are given and the possible transmutations that are responsible are discussed. [See preceding Abstract.] AUTHORS.

***4442. Excitation Curves for Fluorine and Lithium. L. R. Hafstad, N. P. Heydenburg and M. A. Tuve.** *Phys. Rev.* 50. *pp.* 504–514, *Sept.* 15, 1936.—Observations on the α-particles emitted by Li and γ-rays emitted by Li and F when bombarded with protons of energies up to 1000 kV have been improved by the use of a corona-free, 10,000-megohm voltmeter-resistor for voltage measurements. By this means the accuracy of our measurements has been brought to 2 % on an absolute scale and about 1 % on a relative scale. Oscillograph studies of voltage-fluctuations have shown that up to 1000 kV the voltage is constant to $\pm 1 \cdot 4$ % "peak-ripple." For the distribution-curve for voltage *versus* time the "half-maximum" width is about 1 % at 1000 kV. Results thus far obtained for the γ-ray resonances are as follows:

Voltage (kV)	Element	Half-width (kV)
328	F	< 4
440	Li	11
892	F	< 12
942	F	< 15

There is an indication of a weak multiplet structure in F in the region between 500 and 700 kV with a broad but fairly prominent "resonance" at 650 to 700 kV. The existence of a resonance in Li at 850 kV was not confirmed. [See Abstract 3970 (1935).] AUTHORS.

4443. Artificial Radioactivity Reported by Reboul. W. Eichenberger. *Helv. Phys. Acta,* 9. 6. *pp.* 467–489, 1936. *In French.*—Reboul's experiments with semiconducting cells [see Abstract 3785 (1932)] have been re-examined. The results are not due to any form of radioactivity, but to formation of O_3 in the neighbourhood of the grid as a result of the activity of the cell. The O_3 acts on the surface of the substance exposed to it, thereby "activating" it by production of an ozonide, which decomposes in a damp atmosphere with production of H_2O_2, which acts on the photographic plate. Reboul's experiments attributing certain anomalies in connection with the discharge of electrified bodies [see Abstract 3765 (1934)] to a soft X-radiation are also shown to be explicable by the residual polarisation of the dielectric. [See following Abstract.] C. A. S.

4444. Apparent Radiation Caused by Ozone and Ozonides. Remarks on Reboul's Experiments. M. Fierz. *Helv. Phys. Acta,* 9. 6. *pp.* 490–491, 1936. *In German.*—Experiments are described showing that a photographic plate exposed to O_3 or placed in contact with paper, etc., that has been so exposed, or with or near to an ozonide, on development shows markings indicating that the O_3 has acted on the sensitive layer. [See Abstract 2341 (1933) and preceding Abstract]. C. A. S.

***4445. Mass Spectrum Analysis. K. T. Bainbridge and E. B. Jordan.** *Phys. Rev.* 50. *pp.* 282–296, *Aug.* 15, 1936.—A new mass spectrograph is described, important features being linearity of the mass scale over a broad region of the recording plate, elimination of surface charge effects on the electric deflection plate, and use of relatively wide collimating slits at small separation. Thus high resolving power, sensitivity and dispersion are obtained simultaneously. The instrument is employed to test whether isobares differing by one unit in atomic number are unstable or do not exist at all. Definite proof is obtained for the existence of three isobaric pairs Cd^{113} In^{113}, In^{115} Sn^{115} and Sb^{123} Te^{123}. The isotopes Cd^{115}, Sn^{121}, Hg^{197}, Pb^{209} which have been reported as members of isobaric pairs, cannot be present to greater than 1/8, 1/60, 1/2, 1/10, respectively, of the amounts published by Aston. The existence of Pb^{205} is also held to be doubtful. A. H.

***4446. Mass-Spectrograph Study of Ba, Sr, In, Ga, Li, and Na. M. B. Sampson and W. Bleakney.** *Phys. Rev.* 50. *pp.* 456–460, *Sept.* 1, 1936.—A mass spectrograph of the 180° type of 22 cm. radius has been constructed. The magnetic field of 1400 gauss is supplied by permanent magnets and the accelerating potential by a stabilised rectifier. A mass analysis has been made for a number of elements of the ions obtainable from coated filaments. A peak of Sr at mass 84 comprising 0·5 % of the total Sr current, and one of Ba at mass 134 comprising 1·8 % of the total Ba current are concluded to be new isotopes of Sr and Ba, respectively. A search for a third isotope of In was made but none found. The relative abundances of Ga^{69} and Ga^{71} were determined to be 38·8 and 61·2 % respectively. The existence of Li^5 and Na^{22} recently reported by Brewer was not confirmed. Lower limits were placed on other possible isotopes of these elements. AUTHORS.

4447. Mass-Spectrograph Analysis of Beryllium. W. Bleakney J. P. Blewett, R. Sherr and R. Smoluchowski. *Phys. Rev.* 50. *pp.* 545–546, *Sept.* 15, 1936.—A new source of ions suitable for positive ray analysis is developed in the form of a molecular beam from a hot oven. Ions are produced in the beam by electron impact and focussed on the entrance slit of the mass spectrograph by suitable electric fields. The method is applied to the study of Be, but only Be^9 was found. The experiment placed an upper limit on the existence of Be^8 of 1 part in 10^4. AUTHORS.

4448. International Table of Stable Isotopes for 1936. *Rev. Sci. Instruments*, 7. *pp.* 334–335, *Sept.*, 1936.

***4449. Microthermoconductivity Method for the Estimation of Para-Hydrogen and Deuterium. D. D. Eley and J. Z. Tuck.** *Faraday Soc., Trans.* 32. *pp.* 1425–1428, *Sept.*, 1936.—The microthermoconductivity apparatus for the estimation of *para*-hydrogen, invented by A. Farkas and extended by A. and Z. Farkas to the estimation of deuterium, has been modified by Wirtz, who has published a discussion of the technical points concerned [see Abstract 2476 (1936)]. In connection with an investigation of the exchange reaction between H_2 and H_2O, an apparatus similar in some points to that of Wirtz, has been independently developed by the present authors. In view of its importance for this work, and the practical difficulties experienced in its construction, the present details of the apparatus are now rendered available. H. H. Ho.

4450. Motion of Neutrons in Hydrogenous Substances. E. Fermi. *Ricerca Scientifica*, 7. *pp.* 13–52, *July*, 1936.—The theory of the motion of neutrons in hydrogenous substances is developed in two parts. In the first, the slowing down and diffusion of the neutrons due to elastic and non-elastic collision with the protons is worked out on a quantum-mechanical basis. In the second part, the mechanism of the collision is examined and the results are compared with the experimental observations of Amaldi and Fermi. F. C. C.

4451. Interaction of Neutron and Proton. Y. Nishina, S. Tomonaga and H. Tamaki. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 650. *pp.* 61–69, *Aug.*, 1936. *In English.*—The force between neutron and proton is assumed to be of a very short range and to depend on the relative spin orientation of the two particles. The magnitude of the force for either orientation is determined from the observed scattering of neutrons in H_2 at low velocities and from the binding energy of the deuteron. The cross-section for capture is then evaluated considering only the electric dipole moment, and it is shown that at low velocities the probability of capture does not become large enough to account for the experimental results. R. P.

4452. Resonance Capture of Slow Neutrons. H. H. Goldsmith and F. Rasetti. *Phys. Rev.* 50. *pp.* 328–331, *Aug.* 15, 1936.—The energies of neutron groups selectively activating various elements have been measured by means of the boron absorption method. The elements Rh (3·9 min.), Rh (44 sec.), Ag (22 sec.), In (13 sec.), In (54 min.), Ir (19 hr.) and Au (2·7 days) exhibit resonance capture for neutrons of energies between 1 and 5 volts. The elements Mn (2·5 hr.), Cu (5 min.), As (26 hr.), Br (18 min.), Ag (2·3 min.), I (25 min.) Re (20 hr.) seem to be activated only by higher energy neutrons (30–85 volts). There are indications that Gd and Sm have resonance groups within the Cd absorption region (thermal energies). AUTHORS.

4453. Diffusion of Slow Neutrons. D. S. Bayley, B. R. Curtis, E. R. Gaerttner and S. Goudsmit. *Phys. Rev.* 50. *pp.* 461–463, *Sept.* 1, 1936.—The effect of a few elements on the diffusion of slow neutrons in water is investigated. The interpretation of data on the back scattering of neutrons is discussed. AUTHORS.

4454. Scattering of Fast Neutrons by Heavy Nuclei. C. H. Fay. *Phys. Rev.* 50. *pp.* 560–567, *Sept.* 15, 1936.—Neglecting polarisation effects (*i.e.*, contributions to elastic scattering from quasi-stationary states of the nucleus-neutron system), by means of an extension of van Vleck's treatment of the interaction between a neutron and a heavy nucleus [see Abstract 2036 (1934)], slightly modified by Feenberg and Knipp's calculations [see Abstract 7 (1936)], and the method of partial cross-sections curves relating the cross-section for scattering with the velocities of the neutrons (of energies $\ngtr 7 \times 10^6$eV), and with atomic number have been calculated, the latter for neutrons of energies 1, 3, 6, 1·9 and $2{\cdot}4 \times 10^6$eV. The results agree fairly with those obtained experimentally by Dunning and co-workers [see Abstract 3719 (1935)] for Zn, Sn, I, W, Hg and Pb, but not for Cu. They also imply that polarisation effects are probably small. C. A. S.

4455. Valency and Molecular Structure. R. F. Hunter and R. Samuel. *Nature,* 138. *pp.* 411–413, *Sept.* 5, 1936.—The connection between the numerical valency exhibited by an atom and the number of its outside electrons, which prevailed in certain pre-wave mechanical theories of valency and in the theory of Heitler and London, is now shown to be of fundamental importance to the problem, even though it has been

lost sight of in the chemical theories of Lowry, Sidgwick and others, on account of the conception of coordinate covalency, in which only electrons belonging to one of the atoms concerned are made responsible for chemical combination. This conception appears to connect these theories with the theory of molecular orbitals (Herzberg, Lennard-Jones, Mulliken) in that chemical linkage is ascribed to the bonding power of single independent electrons, while the formation of pairs is an essential feature of the theory of Heitler and London. The authors briefly consider the wave mechanical interpretation of bonding power, and make clear the relation of the electron pair bond theory to the single electron bond theory in the method of molecular orbitals. The authors contend that the theory of molecular orbitals only becomes a theory of valency by the introduction of a postulate which identifies non-premoted with bonding electrons and premoted ones with anti-bonding. From new spectroscopic evidence (now briefly reviewed) it is claimed that the latter postulate can no longer be maintained. It is finally maintained that the existence of a second form of non-electrostatic linkage in molecules of the first order is not proved.
H. H. Ho.

4456. Hydrogen Bridges in Ice and Liquid Water. M. L. Huggins. *J. Phys. Chem.* 40. *pp.* 723–731, *June*, 1936.—Evidence for the existence of H bridges in liquid and solid water and against their being symmetrical is reviewed. With sufficiently small energy barriers in the centre of each OHO bridge, synchronised jumps over them of all of the H's in a ring of H bridges are possible. The resulting partial freedom of orientation of the dipoles accounts satisfactorily for the dielectric constant data for ice and liquid water. Reasons are given for considering H-ion in water to be $(H_2OHOH_2)^+$ consisting of a relatively strong, symmetrical H bridge connecting two H_2O groups. By very slight contemporaneous shifts of two hydrogen nuclei, such an ion can, in effect, add OH_2 at one end and lose H_2O at the other, thus shifting the position in the solution of the excess positive charge. This picture thus accounts for the high mobility of the H-ion in water solution. The hydroxide ion is probably OH^- rather than $(HO\ HOH)^-$, the greater repulsion between the oxygen atoms making a symmetrical bridge less likely than in the case of the positive ion. The shift H–O–H . . . . O–H to HO . . . . HOH should occur, but less readily than the corresponding shift in the case of hydrogen ion, hence the mobility should be less, as observed. H. H. Ho.

4457. Structure of Benzene. Part IX. Fluorescent Spectra of Benzene and Hexadeuterobenzene Vapour in the Region of Absorption. C. L. Wilson. *Chem. Soc., J. pp.* 1210–1214, *Aug.*, 1936.—In parts V and VI of this series [see Abstracts 3935 and 3936 (1936)] the high-pressure fluorescence spectra of benzene and hexadeuterobenzene were satisfactorily analysed by the assumption of three electron levels and two vibrational frequencies of the ground state. These levels, $B_0{}^0$ and $C_0{}^0$, have now been directly observed by a method depending on an observation of Cuthbertson and Kistiakowsky [see Abstract 611 (1936)]. Nitrogen at 760 mm. and benzene at 0·1–0·3 mm. gave the best results; this high pressure of foreign gas was necessary because even at 40 mm. the resonance emission was incompletely quenched, the characteristic doublet at 38,212 cm.$^{-1}$ being still prominent. Hexadeuterobenzene gives an analogous spectrum to benzene, and, compared with it, $B_0{}^0$ and $C_0{}^0$ are shifted towards the u.v. by reason of the smaller zero-point energy of the heavier molecule. The separation between the two progressions, now of 142 cm.$^{-1}$ spacing is 79 cm.$^{-1}$. Tables of data are included together with the spectra diagrams in the region of strong absorption. H. H. Ho.

See also Abstracts **4501, 4508, 4548, 4567, 4634, 4729, 4730, 4733, 4742, 4775, 4785, 4787, 4797, 4803, 4841, 4863, 4877.**

COLLOIDS.

4458. Electrolytic Coagulation of Weak Solvated Sols and Electrolytic Activity. Part IV. Wo. Ostwald and H. A. Wannow. *Kolloid Zeits.* 76. *pp.* 159–166, *Aug.*, 1936.—The present paper deals with As_2S_3 sols in concentrated acids. It is confirmed that As_2S_3 sols can be produced in concentrated acids such as H_2SO_4, H_3PO_4, glacial acetic, acetic anhydride and CCl_3COOH. Their stability relationships, particularly their flocculation by water, are studied and discussed. Theoretically, in general, for one sol and one electrolyte of varying concentration there should be three stability and three instability regions. [For Part II see Abstract 2958 (1936) and Part III see Abstract 3947 (1936)]. J. K.

4459. Coagulation of Colloidal Gold. Part I. J. B. Haley, K. Söllner and H. Terrey. Part II. J. B. Haley and H. Terrey. *Faraday Soc., Trans.* 32. *pp.* 1304–1318, *Sept.*, 1936.—Coagulation of a highly-dispersed gold sol causes the primary particles to form, at first, an irregular agglomerate, the individual crystal size of which is the same as that of the original sol. Crystallisation of the primary particles may be brought about by allowing the coagulate to remain in the electrolyte solution. The crystallisation is dependent on the rate of coagulation and is constant over the whole region of rapid coagulation. In this latter region the maximum growth takes place very rapidly. Part II deals with the experimental technique involved in the determination of the particle sizes of the various coagulates. The Scherrer equation was found unsatisfactory for samples which had been diluted with gelatin, *i.e.*, when the sample was no longer strongly absorbing. This confirms the general conclusions of v. Laue, Brill and Cameron. The reported results were calculated from Brill's first modification of v. Laue's theory, which was found satisfactory for placing the results in the correct order of size without reference to their absolute values. AUTHORS.

4460. Diffraction of Light by Colloidal Solutions. A. S. Menon. *Kolloid Zeits.* 76. *pp.* 9–15, *July*, 1936.—The theory of refraction of light is discussed with reference to sols of different particle size and with respect to the relation between length of light-wave and of the small particles. A new method of investigating refraction of sols is described. The apparatus employed is also given. Various As_2S_3 sols and Sb_2S_3 sols are examined. As_2S_3 sols alter very quickly and show under fourteen days a very high degree of depolarisation. J. K.

4461. Elastic Properties of Highly Polymerised Substances. W. Kuhn. *Kolloid Zeits.* 76. *pp.* 258–271, *Sept.*, 1936.—Passage of caoutchouc from the unstretched to the stretched state involves the loose fibre molecules in a statistical change of length, breadth and thickness. The size and sense of these changes depends on the orientation of the molecules relative to the direction in which the extension is imposed. In addition to this deformation there is a dependent translation of the molecular centre of gravity. While the latter translations involve no changes of entropy, those changes connected with molecular form probably involve changes of molecular state and therefore bring about changes of entropy. The formula developed affords for the various varieties of caoutchouc molecular weights varying from 20,000 to 100,000. The elastic tension in the stretched caoutchouc corresponds to a reverse tendency to a more probable state and has nothing to do with energy changes. The extensible-elastic state for small deformations can be described as similar to that of a liquid for large displacements. H. H. Ho.

Schoen

***4462. Rubber of Meteorological Balloons. P. Berger.** *Helv. Phys. Acta*, 9. 5. *pp.* 372–388, 1936. *In French.*—Paper refers to meteorological balloons sent up daily at air-ports. Many are inflated to 9000 % and at 7000 m. the volume inflation may reach 18,000 %. The author attempts by a consideration of the physical and chemical properties of vulcanised and unvulcanised rubber to determine why it is possible to obtain this large increase in size and why a balloon bursts at a certain height. J. K.

4463. Swelling Pressures of Isinglass in Water and Aqueous Solutions. H. Freundlich and P. S. Gordon. *Faraday Soc., Trans.* 32. *pp.* 1415–1424, *Sept.*, 1936.—The swelling pressure of isinglass in water and aqueous solutions of a number of electrolytes and a few non-electrolytes (urea and cane sugar) has been determined at room-temperature with a device similar to that of Posnjak. This could be done because isinglass is peptised in these solutions much less than gelatin. The swelling is reversible, and the equation correlating the swelling pressure Π and the concentration of the gel γ (in gm. of isinglass per 1000 c.c. of isinglass and liquid) is: $\Pi = \Pi_0\gamma^k$, Π_0 and k being constants. The effects of different ions were compared at a salt concentration of $0 \cdot 2\ n$. As to the intensity of their effects, the ions may be arranged in Hofmeister's series $Li < Na < K$ and $SO_4 < F < C2 < NO_3 < I < CNS$. The influence of the electrolyte concentration C was investigated thoroughly only in NaCl solutions. A minimum of swelling near the isoelectric point has also been found as in other cases. The swelling of isinglass decreases markedly in the presence of sugar. H. H. Ho.

4464. Liesegang Rings in Non-Gel-Like Media. Part I. V. Gore. *Kolloid Zeits.* 76. *pp.* 193–200, *Aug.*, 1936.—It is pointed out that very carefully washed precipitates of Fe, Al, Cr and Ce hydroxide as well as Ca, Sr and Ba carbonate can be peptised into emulsoid sols by the aid of electrolytes and that these sols can by slow coagulation form narrow, variously coloured rings. J. K.

4465. Effect of Vulcanisation on Gutta-Percha. C. S. Fuller. *Indust. and Engin. Chem.* 28. *pp.* 907–912, *Aug.*, 1936.—The author verifies that gutta-percha and balata have identical X-ray patterns. Vulcanisation has no effect in changing the lattice plane spacings of either the α- or β-crystal modifications of gutta-percha. It is shown that a partial transformation of the β- to the α-form of gutta-percha results by stretching at 80° J. K.

4466. Production of Spun Threads from Liquid Systems. H. Erbring. *Kolloid-Beihefte*, 44. *pp.* 171–237, *Aug.*, 1936.—Spun liquid threads were prepared by drawing a thick-walled glass capillary at adjustable speed vertically out of a body of liquid, the length of thread (before rupture) obtained for a given drawing speed being adopted as a measure of "spinnability." Thread-length increases linearly with drawing speed but declines after passing through a maximum. No consistent relation between surface tension and spinnability was found. High viscosity does not necessarily endow a liquid with spinning properties though for spinnable liquids thread-length increases with viscosity, generally passing through a maximum. Spinnable liquid systems are colloidal in character and exhibit structural viscosity (non-conformity with the Poiseuille-Hagen law, thixotropy, etc.); moreover such systems exhibit a maximum spinnability over a transition range (*e.g.* of temperature) at which separation phenomena occur. This does not imply complete separation into two liquid phases, as in the system phenol-water, but rather the type of change (coazervation) which occurs when a gelatin sol becomes turbid on cooling. Spinnability is likewise a maximum at an *intermediate* stage of polymerisation (*e.g.* in polysterols), of concentration (*e.g.* in colloidal dye solutions) and of structure-development (*e.g.* in the sol-gel transformation in gelatin and viscose). These points are illustrated by studies of vegetable (linseed, quince seed) extracts, acetyl cellulose in acetone, cotton yellow dye in water, aluminium soaps of lauric and myristic acids, polysterols, gelatin-phenol and gelatin-starch systems, solutions in water of sodium stearate and of sodium silicate-hydrochloric acid, polyvinyl alcohols and the "ripening" of viscose as affected by NH_4Cl. In the last-named example, technical practice is shown to conform with conditions of maximum spinnability. L. V. C.

4467. Electric Charge Effects and Dispersing Action of Soaps. W. M. Urbain and L. B. Jensen. *J. Phys. Chem.* 40. *pp.* 821–832, *June*, 1936.—The mechanism is discussed whereby soaps render emulsions of oily materials and suspensions of inert materials relatively stable. The detergent action of soap is thus more completely explained. The effect of soaps on the ζ-potential of the oil droplets of typical oil-in-water and on the ζ-potential of certain inert materials shows in both cases that the presence of soap creates an increase in the value of the negative ζ-potential. Very high values are obtained for oil globules of emulsions, which account for their stability. The ζ-potentials of the particles of inert material suspended in soap solutions were appreciably higher than those obtained in solutions of other salts. For the fatty-acid series, the potential increases with the length of the carbon chain of the fatty acid present. Free alkali present is insufficient to account for the large effect of soaps on the ζ-potential. At 75° soaps prepared from mixtures of oleic and stearic acids have the same effect as soaps prepared from the individual fatty acids. Soaps producing a high negative potential on certain carbon particles also form a stable suspension of the carbon, and conversely. The effect of increasing the ζ-potential of oil droplets of an emulsion and of particles of a suspension is suggested as the mechanism whereby soaps act as emulsifying and deflocculating agents, hence measurement of the effect of a solution of a soap on the ζ-potential of the oil droplets of an emulsion is suggested as a means of evaluation of the detergent powers of the soap. S. G. B.

4468. ζ-Potential and Stability in Emulsions. C. Robinson. *Faraday Soc. Trans.* 32. *pp.* 1424–1425, *Sept.*, 1936.—Harkins and his co-workers have shown that the stability of an emulsion increases in general as the emulsifying film changes from an expanded to a condensed film. A theoretical point, however, giving one reason for the importance of the condensed monomolecular film, has not been previously discussed, and is dealt with in the present note. It is pointed out from ζ-potential considerations that when dealing with the stability of oil emulsions stabilised by paraffin chain ions, it is most important to determine the concentration of solution which will give a surface concentration nearly that corresponding to a condensed monomolecular film. This surface concentration will probably be attained with a solution concentration of paraffin chain electrolyte which gives the maximum lowering of interfacial tension. On the other hand, cataphoretic measurements will be of little interest, as these can only give the ζ-potential of the isolated drops. H. H. Ho.

See also Abstracts **4561, 4799, 4807, 4829, 4837.**

CRYSTAL STRUCTURE AND PROPERTIES.

4469. Lattice-Theory of Alkaline Earth Carbonates. Part I. B. Y. Oke. *Indian Acad. Sci., Proc. 4A. pp.* 1–10, *July,* 1936.—The lattice-energies of crystals of aragonite, of $SrCO_3$, and of $BaCO_3$, which are all of the orthorhombic type, are calculated. Further the value of *n* is calculated with the help of the compressibility measurements. The lattice-energy values are verified by a thermochemical cyclic process. AUTHOR.

4470. Nature of Solid Solution of Antimony in Lead. N. W. Ageew and I. W. Krotov. *Inst. of Metals, J.* 59. [8 *pp.*], 1936. *Advance Copy.*—X-ray analysis and density determinations show that the solid solution of Sb in Pb is of the simple monatomic type. The thermodynamic analysis is not in contradiction to this conclusion if errors of the order of 2° C. are assumed to exist in the equilibrium diagram. AUTHORS.

4471. Oxide Films on Metal Surfaces. Part I. Cu and its Alloys. S. Miyake. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 636. *pp.* 167–178, *July,* 1936. *In English.*—The structure and composition of the surface films formed by heating Cu and some of its alloys in air are determined by electron diffraction. It is found that with pure Cu, ordinary bronze, Mn bronze, Cu-Mg and Cu-Ni alloys, a Cu_2O film is formed up to 200° C., but a CuO film results at higher temperatures. It is suggested that an intermediate CuO′ film is formed at 300°–550° C., since the corresponding pattern invariably yields the 011 diffraction of monoclinic CuO ($a = 4\cdot66$, $b = 3\cdot40$, $c = 5\cdot09$ Å, $\alpha = 99°30'$) whilst this ring is missing from X-ray patterns of tenorite and from the electron diffraction patterns afforded by films formed at higher temperatures. The oxidation products of Al bronzes containing more than 3 % Al are found to be dependent upon the method of heating. On heating in an electric furnace the alloy behaves like pure Cu and becomes coated with a black layer of CuO, whilst no change in surface colour is observed even after prolonged heating in a gas flame, although the electron diffraction patterns show that the surface is covered with a thin film of cubic γ–Al_2O_3 ($a = 7\cdot96$ Å) which protects the surface from further oxidation. It is suggested that the supply of O_2 in the gas flame is limited, and owing to the fact that Al has a greater affinity than Cu for O_2, the circumstances are such that the formation of γ-Al_2O_3 is favoured in spite of the low Al content. Brass containing 30 % Zn is found to be covered with ZnO after heating to 700° C. in the oxygen-rich atmosphere of an electric furnace, whilst CuO is the ultimate product with gas heating. It is shown that the oxidation-resisting properties of Be bronze containing as little as 2 % Be is due to the formation of a protective surface layer of BeO. The electron diffraction patterns are reproduced. A. G. Q.

4472. X-Ray Studies on Electrodeposited Silver. S. Basu and M. Hussain. *Indian Journ. Phys.* 10. *pp.* 267–274, *July,* 1936.—The work of W. A. Wood [see Abstract 4805 (1935)] with Ni is extended to Ag, confirming, in a general way, his conclusions as regards correlation between current density and selective orientation and between hardness and breadth

of diffracted lines. Intensity measurement is extended to lines of planes 111,200,220,311 and 222 of Ag for different current densities. The brightness of the electrically-deposited surfaces is estimated photographically, giving a better estimate of the lustre than the visual estimate of Wood.
AUTHORS.

4473. Structure of Metallic Deposits on a Copper Single Crystal. W. Cochrane. *Phys. Soc., Proc.* 48. *pp.* 723–735, *Sept.* 1, 1936.—Ni, Cu, Zn, Cd, Ag, Cr, and Co were deposited electrolytically on etched copper single crystals and the structure of the deposits was found by electron diffraction. At small current densities the layers are oriented except in the case of Zn and Cd. The Ni and Co deposits give patterns containing additional spots, lines and irrational spots. It is shown that these are accounted for by assuming the occurrence of repeated twinning on (111) planes, the additional spots being due to twinned lattices and the lines due to twin planes. The twin planes must be considered separately and not simply as part of the lattices on either side of them. The thin sheets of lattice thus formed give rise to the irrational spots observed. Finally, a discussion is given of the factors determining the orientation of a layer of metal on the copper crystal. AUTHOR.

4474. Lattice Spacings of Primary Solid Solutions in Silver and Copper. W. Hume-Rothery, G. F. Lewin and P. W. Reynolds. *Roy. Soc., Proc.* 157 *A.pp.* 167–183, *Oct.* 1, 1936.—Accurate measurements have been made of the lattice spacings of the primary solid solutions of Cd, In, Sn and Sb in Ag, and of Zn, Ga, and Ge in Cu. In each series of alloys increasing valency results in increased lattice distortion at equal atomic percentages of the solute elements. In dilute solid solutions in Ag equal atomic percentages of Cd, In, Sn, and Sb expand the lattice of Ag by amounts proportional to 2 : 3 : 4 : 6 respectively; this whole number relation holds to an accuracy equivalent to 1 part in 20,000 in the measurements of the lattice spacings, and ± 0·05 % in the compositions of the alloys. In the dilute alloys of the Cu series, equal atomic percentages of Zn and Ga expand the lattice of Cu by amounts proportional to the factors 3 : 4. The corresponding factor for Ge is, however, 4·8 and not 5. The general conclusion is, therefore, that, whilst whole number relations exist in both series, the effect of increasing valency is less marked in the Cu series. It is suggested that in both series increasing valency tends to expand the lattice, but that this expansion is opposed by some factor which is relatively more important in the copper series. This opposing factor may be due to a contraction of the atom with increasing atomic number, since the change in atomic number resulting from one step in the periodic table is relatively less for the elements following Ag of atomic number 47 than for those following Cu of atomic number 29. AUTHORS.

4475. Atomic Rearrangement Process in the Copper-Gold Alloy Cu_3Au. C. Sykes and F. W. Jones. *Roy. Soc., Proc.* 157*A. pp.* 213–233, *Oct.* 1, 1936.—The effect of the atomic rearrangement process on the energy content of the alloy Cu_3Au has been determined experimentally. The results are compared with those predicted by the theories of Bragg and Williams, and Bethe and Peierls, and it is shown that the latter theory gives the best approximation. From an examination of the behaviour of the alloy in certain metastable states, it has been deduced that the energy of any atom is fixed only by the identity of its neighbours within two atomic distances. Consequently a large proportion of the energy of the ordering process is released by the time the regions of consistent order attain a length of 5×10^{-7} cm. The electrical resistance of the alloy, on the other hand, starts to diminish when the ordered regions are about 5×10^{-7} cm. long, and has not reached the equilibrium value even when these regions are 3×10^{-6} cm. long. AUTHORS.

4476. X-Ray Investigation of Minerals. W. L. Bragg. *J. de Physique et le Radium*, 7. *pp*. 321–325, *Aug.*, 1936.—Si and Al occur surrounded tetrahedrally by four O atoms; Fe, Mg and sometimes Al octahedrally by six O atoms; the large atoms Na, Ca and K form wide bundles often irregularly placed. In olivine the tetrahedra are separated by octahedra yielding a hard, compact, transparent crystal without marked cleavage. In pyroxenes and amphiboles the tetrahedra are connected at the corners into long chains, cemented laterally by parallel chains of octahedra yielding a characteristic fibrous structure, *e.g.*, asbestos. Cleavage planes occur at 90° and 56° respectively compared with 93° and 56° calculated for single and double chains. In micas tetrahedra occur in laminæ above one another like the pages of a book but in those with an internal NH_4I sub-structure, cleavage is less marked. In felspars tetrahedra form groups $(Al,Si)O_2$, light atoms falling in the empty spaces, but since the Fe and Mg octahedra do not readily fit in, these elements are not found. K atoms *distort* the structure to *more symmetrical* orthoclase $K\,Al\,Si_3O_8$, but Ca and Na atoms are not large enough to do this. In quartz SiO_4 tetraheda are connected by the corners. Closest packing occurs in a tetrahedra + octahedral structure as in olivine (3·4), while quartz (2·65) and felspars (2·75 — 2·5) are lightest. Geometrical arrangement is therefore consistent with the isostatic principle. D. R. H.

4477. Systematic Investigation of Superstructures, Applied to the Arsenopyrite Crystal Structural Type. M. J. Buerger. *Zeits. f. Krist.* 94. *pp* 425–438, *Sept.*, 1936. *In English.*—A new procedure is presented for the systematic investigation of superstructures of a given simple structure, and is applied to the arsenopyrite structural type, for which the formal structure theory approach does not lead to a solution of the crystal structure type. On the basis of X-ray evidence, the arsenopyrite type bears a superstructure relation to the marcasite-type. On the basis of geometrical X-ray evidence, the superstructure conditions require a doubling of the *a* and *b* axes and a centreing of the C face. Simple qualitative intensity data also indicate an identical atomic population in all (100) sheets. A development based upon plane groups and a simple algebra then show that these conditions are consistent with only five distinct superstructures. The algebra automatically gives the symmetry of the resulting structural types: two are Cm, one is $C2$ with an enantiomorphous equivalent, and two are $C2_1/d \rightarrow B2_1/d$. Since the arsenopyrite group gives orthorhombic diffraction effects, any "crystal" must be a twinned composite to account for the additional symmetry. The twins thus predicted have actually been found. The correct structure of the five possibilities is one of the two monoclinic holohedral possibilities. AUTHOR.

4478. Structure of Polysulphides: Part I. Barium Trisulphide. W. S. Miller and A. J. King. *Zeits. f. Krist.* 94. *pp*. 439–446, *Sept.*, 1936. *In English.*—A study is made of the structure of BaS_3 with the view of determining the configuration of the S_3 ion. BaS_3 has an orthorhombic lattice, $a_0 = 8{\cdot}32$ Å, $b_0 = 9{\cdot}64$ Å, $c_0 = 4{\cdot}82$ Å; $a:b:c = 0{\cdot}86:1:0{\cdot}50$. Its space group is $P_{2_12_12}$ with four molecules in the unit cell. The trisulphide ion is made up of three S atoms distributed at an angle of approximately 103°

to one another. The S — S distance within the ion was found to be 2·15 Å, which agrees with results found in previous work with polythionates and sulphur. The radius of the end S atoms external to the ion is 1·75 Å in agreement with that found in BaS. The central S atom has an apparent radius of 1·32 Å. AUTHORS.

4479. Structure of Potassium Nitrite. G. E. Ziegler. *Zeits. f. Krist.* 94. *pp.* 491–499, *Sept.*, 1936. *In English.*—A determination of the complete structure of KNO_2 on the basis of the agreement between calculated structure factor expressions and observed intensities of reflections as obtained by means of oscillation photographs. The KNO_2 unit cell contains 2 molecules and is face centred monoclinic with dimensions: $a = 4{\cdot}45$; $b = 4.99$; $c = 7{\cdot}31$ Å; $\beta = 114°50'$. The space group is C_2^3. The parameter values were determined by first limiting them to definite ranges by making use of intensity data from the (h 00), (0k0), and (00l) spectra, and finally fixed by trial calculations. The final parameters in degrees are:

	x	y	z
K	0	0	0
N	180	0	175
O	160	75	150

K is surrounded by 6 O atoms at an average distance of 2·82 Å. The NO_2 group is angular with an angle of 132° between the N to O bonds. The distance from N to O is 1·14 Å and from O to O in NO_2 2·08 Å. The small O to O distance in NO_2 is accounted for on the basis of repulsion between successive NO_2 groups. The structure may be considered a distorted $NaNO_2$ type structure, and it is concluded that the crystal has a large birefringence, and that the vibration direction of γ is parallel to the (b) axis and the vibration direction of a is nearly perpendicular to the plane (101). AUTHOR.

4480. Structure of Germanium Disulphide. W. H. Zachariasen. *J. Chem. Phys.* 4. *pp.* 618–619, *Sept.*, 1936.—Crystals of GeS_2 are orthorhombic. The unit cell contains 24 molecules and has dimensions: $a = 11{\cdot}66$, $b = 22{\cdot}34$, $c = 6.86$ Å. Accuracy $\frac{1}{2}$ %. The space group is *Fdd* ($C_{2v}{}^{19}$). Eight of the Ge atoms are situated on the twofold axes; all other atoms occupy general positions. The twelve parameters involved have been determined. Every Ge atom is tetrahedrally linked to four S atoms, with an interatomic distance of 2·19 Å. The angle between the two S bonds is 103°. A three-dimensional network somewhat similar to the silica networks is formed. AUTHOR.

4481. Structure of $H_3PW_{12}O_{40}{\cdot}29H_2O$. A. J. Bradley and J. W. Illingworth. *Roy. Soc., Proc.* 157*A*. *pp.* 113–131, *Oct.* 1, 1936.—The higher hydrate of phosphotungstic acid, $H_3PW_{12}O_{40}{\cdot}29H_2O$, is cubic. The unit cell contains 8 molecules and the length of the edge of the cell is 23·28 Å. The anion $(PW_{12}O_{40})^{-3}$ is identical with the one found by Keggin in the lower hydrate $H_3PW_{12}O_{40}{\cdot}5H_2O$. The structure consists of two interpenetrating diamond lattices, the one of $(PW_{12}O_{40})^{-3}$ anions and the other of groups of 29 molecules of water of crystallisation. The positions of all the atoms, with the exception of the H's have been found. A feature of the work is that the structure was entirely determined from one powder photograph taken by Keggin. The remarkable number (29) of water molecules associated with each anion is accounted for by symmetry considerations. These are divided up into 5 groups, *viz.*, 12 + 6

+ 6 + 4 + 1. It is interesting to note that the interatomic distances of the water molecules all lie between 2·8 and 2·9 Å. The packing of these molecules is quite open, in contrast to the O atoms in the anion, which are very closely packed. Authors.

***4482. Structure of Condensed Aromatic Hydrocarbons and their Molecular Compounds with Trinitrobenzene. E. Hertel and H. W. Bergk.** *Zeits. f. phys. Chem.* 33. *Abt.B.* 5. *pp.* 319–333, 1936. An X-ray and crystallographic study has been made of 2 : 3-benzanthracene perylene and of two molecular compounds in which there is a 1 : 1 ratio of molecules of perylene and pyrene respectively with 1 : 3 : 5-trinitrobenzene. The crystal data are as follows. (1) 2 : 3-*Benzanthracene*, triclinic crystals with m.p. = 394° C. were obtained by vacuum sublimation; $a = 7{\cdot}94$Å., $b = 6{\cdot}02$Å., $c = 13{\cdot}5$Å., $\alpha = 80°40'$, $\beta = 67°50'$, $\gamma = 92°40'$; density = 1·35; 2 mol. per cell. (2) *Perylene*, monoclinic; m.p. = 274° C.; $a = 10{\cdot}3$Å., $b = 10{\cdot}8$Å., $c = 13{\cdot}6$Å., $\beta = 126{\cdot}5°$; density = 1·35; 4 mol. per cell; space group = $C_{2h}^5 - P2_1/n$. (3) *Perylene-trinitrobenzene*, black orthorhombic crystals, m.p. = 276° C.; $a = 7{\cdot}2$Å., $b = 9{\cdot}6$Å., $c = 31{\cdot}5$Å.; density = 1·42; 4 mol. $\{C_{20}H_{12}{\cdot}C_6H_3(NO_2)_3\}$ per cell; space group = $D_2^4 - P2_12_12_1$. (4) *Pyrene- trinitrobenzene*, pale-yellow triclinic needles; $a = 6{\cdot}7$Å., $b = 8{\cdot}4$Å., $c = 16$Å., $\alpha = 87°$, $\beta = 84°$, $\gamma = 77°$; density = 1·46; 2 mol. $\{C_{16}H_{10}{\cdot}C_6H_3(NO_2)_3\}$ per cell. 2 : 3-Benzanthracene does not appear to form a molecular compound with trinitrobenzene. The authors discuss the probable molecular arrangement in the unit cells of the compounds studied. A description and diagram is given of a high vacuum sublimation apparatus for growing single crystals, purifying substances and effecting separations. J. I.

4483. Structure of Phthalocyanine. J. M. Robertson. *Chem. Soc., J. pp.* 1195–1209, *Aug.*, 1936.—The present paper gives the results of a quantitative determination of the structure of free phthalocyanine, $C_{32}H_{18}N_8$, space group C_{2h}^5 ($P2_1/a$), $a = 19{\cdot}85$, $b = 4{\cdot}72$, $c = 14{\cdot}8$ Å., $\beta = 122{\cdot}25°$, which has two centro-symmetrical molecules per unit cell of volume 1173 Å^3; d (found) = 1·44; (calc.) = 1·445, $M = 514$, $F(000) = 532$. Author.

4484. Structures of Alkyl Metallic Complexes. A. F. Wells. *Zeits. f. Krist.* 94. *pp.* 447–460, *Sept.*, 1936. In English.—Triethylarsine cuprous iodide is shown to exist in the solid state as 4-fold molecules $Cu_4I_4(Et_3As)_4$, and a detailed analysis of the structure is given. The molecular weights of analogous compounds in organic solvents indicates that this is also the form in which such compounds exist in solution. Short notes are added on two other similar compounds, $(C_4H_9)_3P{\cdot}CuI$ and $(C_2H_5)_3As{\cdot}AgI$, and it is shown that by utilising the conception of 4-fold macro-molecules some progress may be made towards determining the structures of such compounds. The unit cells and space-groups are summarised here :—(1) $Et_3As{\cdot}CuI$.—cubic, $a = 13{\cdot}08 \pm 0{\cdot}02$Å.; density 2·05; 8 molecules per unit cell; space-group $I\bar{4}3m$.; point symmetry of macro-molecule $\bar{4}3m$. (2) $Bu_3P{\cdot}CuI$.—trigonal, $c = 23{\cdot}7$, $a = 22{\cdot}4$ Å.; density 1·47; 24 molecules per unit cell; space-group $C3c$; point symmetry 1 (C_1). (3) $Et_3As{\cdot}AgI$.—tetragonal, $c = 19{\cdot}7$, $a = 10{\cdot}7$ Å.; density 2·24; 8 molecules per unit cell; space-group $I\bar{4}m2$ or $I\bar{4}2m$.; point symmetry $\bar{4}2m$. Author.

4485. Structure of Resorcinol. J. M. Robertson. *Roy. Soc., Proc.* 157*A*. *pp.* 79–99, *Oct.* 1, 1936.—Resorcinol forms strongly polar crystals, space group C_{2v}^9 (Pna), with four asymmetric molecules to the unit cell. A quantitative X-ray investigation based on absolute intensity measurements of about 100 reflections from the axial zones has led to a complete determination of the structure, and the results have been refined by means of three double Fourier syntheses giving projections of the molecules along the crystal axes. The benzene rings are regular plane hexagons, the distance between the carbon atoms being ·139±0·01 Å. The centres of the OH groups (oxygen atoms) lie at 1·36 Å from the centres of the ring C atoms. The orientation of the molecule and the coordinates of all the atoms are given. In the crystal the molecules are grouped in spiral arrays about the two-fold screw axes, the OH groups of successive pairs of molecules approaching each other to within about 2·7 Å, an intermolecular distance which indicates the presence of OH bonds. The minimum distances of approach between the other atoms on adjoining molecules (C to O, and C to C) are all 3·5 Å or more. AUTHOR.

4486. Effect of Sudden Heating on Recrystallisation of Metals. U. Yoshida, S. Nagata and C. Mitsuki. *Kyoto Coll. Sci., Mem.* 19. *pp.* 169–180, *May*, 1936. *In English.*—In recrystallising thin Al plates the effect of sudden heating to a recrystallisation temperature belonging to the germinative temperature range upon the grain number is investigated, and it is found that the grain number is much greater in this case than when the plate is heated gradually up to the same recrystallisation temperature. In the case of gradual heating, a few seeds or crystal nuclei which are to be grown to tolerable size afterwards in the germinative temperature range seem to be formed among an immense number of the recrystallised metal crystals already in the recrystallisation temperature range lower than the germinative temperature. AUTHORS.

4487. Thermal Transitions in Copper Sulphate Pentahydrate. T. I. Taylor and H. P. Klug. *J. Chem. Phys.* 4, *pp.* 601–607, *Sept.*, 1936.—A study of the thermal transitions in $CuSO_4$, $5H_2O$ has been made from warming curves obtained by a differential thermocouple method. Small transitions were observed at 29° C., 35° C., 53·7° C., and dehydrations at 96·5° C., 102° C., and at 113° C. The first three of these may be interpreted as transitions from oscillation to rotation of the water molecules in the crystal. The last three are associated with the stepwise dehydration to the tetra-, tri-, and monohydrates, respectively. The existence of the tetrahydrate, not previously known, has been demonstrated. A discussion of the dehydration in the light of its crystal structure is given. A mechanism of dehydration by heat, based on the concept of molecular rotation, is suggested. AUTHORS.

4488. Thermal Diffusion of Colour Centres in KCl Crystals. O. Stasiw. *Göttingen Nachrichten, Fachgruppe II.* 2. 11. *pp.* 131–137, 1936.—The diffusion of colour centres in KCl crystals is measured at various temperatures. An electric field is used to decolorise half of a homogeneously-coloured crystal and the crystal is then kept at a constant temperature. Figures are given showing the independence of diffusion number on the concentration of colour centres. [See Abstract 4312 (1934).] J. I.

4489. Number of Colour Centres in KCl Crystals. F. G. Kleinschrod. *Ann. d. Physik,* 27. 2. *pp.* 97–107, *Sept.*, 1936.—Direct chemical estimation of the free K in coloured KCl crystals shows that the number of colour centres present is about 1·3 times larger than that obtained by optical (absorption) measurements. C. B. A.

4490. Verification of Huygens Wave Surfaces in Uniaxial Crystals. W. R. Wright and M. W. Garrett. *J.O.S.A.* 26. *pp.* 360–362, *Sept.,* 1936.—A direct simple experimental method, requiring only a microscope, for verifying the existence and form of the Huygens wave surfaces in doubly refracting uniaxial crystals is described and explained. C. B. A.

4491. Alteration in Volume on Magnetisation and the Invar Alloys. U. Dehlinger. *Zeits. f. Metallkunde,* 28. *pp.* 194–196, *July,* 1936.—It is shown that, from the exchange integral derived from measurements of the saturation moment, the diminution in volume by demagnetisation in the neighbourhood of the Curie point observed by Köster and Schmidt may be deduced without any assumptions. The curves show that the volume alteration is particularly steep (and linear) in the invar alloys; the properties of invar may thus be explained. [See also Abstract 2972 (1936).] H. J. H. S.

4492. Tensile Properties of Solid Mercury. C. H. Lander and J. V. Howard. *Roy. Soc., Proc.* 156*A. pp.* 411–426, *Aug.* 17, 1936.—The mechanical strength of Hg at temperatures near its melting point is measured in a testing machine using test pieces 1 in. in dia. and 3½ in. long. The samples are cast in position by passing liquid air through a central core tube of Cu. Load-extension diagrams are obtained over the range 17 to − 130° C. by means of the Dalby recorder. These diagrams have the same general characteristics as those of other metals, *viz.,* an elastic line, a curve of plastic deformation and a final drop to fracture, which, in Hg, extends down to the extension axis. The diagrams of Pb, Zn, duralumin, steel and Ni possess distinguishing features. The total extension of solid Hg decreases with fall in temperature but irregularities in this respect suggest a coarsely crystalline structure. H. J. H. S.

4493. Temperature Variation of the Elastic Moduli of NaCl, KCl and MgO. M. A. Durand. *Phys. Rev.* 50. *pp.* 449–455, *Sept.* 1, 1936. The principal adiabatic and isothermal elastic moduli and elastic constants of NaCl, KCl and MgO have been measured over the temperature ranges 80° K. to 270° K. (Balamuth and Rose), and 270° K. to 480° K. for NaCl; 80° K. to 280° K. for KCl; and 80° K. to 560° K. for MgO. The Debye characteristic temperatures of these substances at 80° K., calculated from the adiabatic elastic constants, are 320° K., 246° K. and 946° K. respectively. The variation of the isothermal c_{11} and c_{44} with temperature is described very accurately by the formula: $(c_{ii})_u = (c_{ii})_0 \exp(-A_{ii}F_{ii}(u))$ where $u = (T/\theta)$, T is the absolute temperature and θ the characteristic temperature, $(c_{ii})_0$ denotes the value at absolute zero, A_{ii} is a constant of the material, and $F_{ii}(u)$ is a function of u which assumes the value unity when $u = 1$, and which is the same for all three substances. Experimental values of $F_{11}(u)$ and $F_{44}(u)$ are given for values of u between 0·1 and 1·5. The isothermal c_{12} does not vary with temperature, over the specified ranges, by more than the error of measurement. AUTHOR.

4494. Temperature Dependence of Crystal Plasticity. E. Orowan. *Zeits. f. Physik,* 102. 1–2. *pp.* 112–118, 1936.—In the work of Boas and Schmid [see Abstract 3457 (1936)] the quantity A/T (not A alone) must be regarded as temperature dependent when considering the conditions during transitions at low temperatures. Taking this into account eliminates the apparent contradiction between the Becker formula and experience. In consequence of the intensified solidification and occurrence of flaws in the crystals investigated, no satisfactory conclusions may be drawn with respect to velocity of flow from the low temperature experiments of Boas and Schmid. On the other hand, the work at room-temperatures is practically free from these objections, and the Becker formula is confirmed for crystals of Cd, Bi and Sn which have hitherto not been investigated. H. H. Ho.

***4495. Machine for Drawing Pole-Figures Directly from X-Ray Diffraction Patterns. D. McLachlan, Jr.** *Rev. Sci. Instruments*, 7. *pp*. 301–304, *Aug.*, 1936. *Zeits. f. Krist.* 94. *pp*. 500–505, *Sept.*, 1936. *In English.*—The author describes the construction of a machine which enables stereographic pole-figures to be drawn from a monochromatic X-ray diffraction pattern. By means of these pole-figures it is possible to express the preferred orientations of crystals in the specimen examined. Diagrams are given showing the construction and assembly of the various parts of the machine. It is claimed that with this apparatus one can draw every direct contribution of an X-ray diffraction pattern to the pole-figures of a crystallographic plane within five minutes of setting up the pattern on the machine. J. I.

4496. Structure-Factor Graphs for Crystal Analysis. W. L. Bragg. *Nature*, 138. *pp*. 362–363, *Aug*. 29, 1936.—The use of contoured graphs for determining the configuration of atoms in crystals, from X-ray data, is explained and illustrated diagrammatically. The analysis of atomic positions, it is claimed, can be more rapidly carried out with the graphs than by calculation. AUTHOR.

4497. Improved Numerical Method of Two-Dimensional Fourier Synthesis for Crystals. H. Lipson and C. A. Beevers. *Phys. Soc., Proc.* 48. *pp*. 772–780, *Sept.* 1, 1936.—It is shown that a two-dimensional Fourier summation for a crystal without a centre of symmetry can be resolved into one-dimensional summations, and these latter can be calculated very rapidly by using a set of printed strips which give cosine and sine waves of different wave-lengths and amplitudes. The most useful interval of division of the strips, and various features concerning their use, are described. AUTHORS.

See also Abstracts 4629, 4642, 4755, 4756, 4833, 4834, 4873, 4877, 4878, 4883.

DENSITY.

4498. Density of Hydrocarbon Gases and Vapours at High Temperature and Pressure. W. B. Kay. *Indust. and Engin. Chem.* 28. *pp*. 1014–1019, *Sept.*, 1936.—The P V T relations of 11 typical petroleum hydrocarbon mixtures in the gaseous state are determined experimentally over a wide range extending from the saturated condition below to the highly superheated condition above the critical region. The P-V-T data on the mixtures, expressed as deviations from the perfect gas law, are correlated with similar data on pure hydrocarbons by means of the theorem of corresponding states using a particular temperature and pressure for each mixture, termed the " pseudocritical temperature and pressure," for calculating the corresponding reduced quantities. Methods and charts for estimating the pseudocritical temperature and pressure are given which make possible the calculation of the P V T relations over a wide range. AUTHOR.

4499. Density of Slightly Soluble Powders. U. Yoshida, S. Matano and M. Watanabe. *Kyoto Coll. Sci., Mem.* 19. *pp*. 161–168, *May*, 1936.—A method of measuring the net density of a powder by immersing in a liquid which dissolves a small quantity of the substance, is described. The net density of picric acid is measured by this method by immersing it in water, and the value of 1·7642 is obtained for purified picric acid. AUTHORS.

See also Abstracts 4470, 4513.

DIFFUSION AND OSMOSIS.

4500. Diffusion of Copper Sulphate in Aqueous Solutions of Sulphuric Acid. A. F. W. Cole and A. R. Gordon. *J. Phys. Chem.* 40. *pp.* 733–737, *June*, 1936.—Data covering the concentration ranges 0–0·6 N $CuSO_4$ and 0–7·6 N H_2SO_4 were determined by Northrup and Anson's method, which employs diffusion between equal volumes of the two liquids across a Jena sintered glass diaphragm. The diffusion constant k of $CuSO_4$ at 18° C. varied linearly with concentration c, both the absolute value of k and the slope of the (k,c) curve varying with H_2SO_4 concentration. There was evidence of H_2SO_4 diffusion into the $CuSO_4$ cell. It is shown that with a linear (k, c) relation the applicable solutions of the diffusion equation (which assumes k independent of c) give a correct k for a value of c which is one half of its initial value. L. V. C.

4501. Osmotic Pressure of Gum Arabic. H. B. Oakley. *Faraday Soc., Trans.* 32. *pp.* 1360–1364, *Sept.*, 1936.—From osmotic pressure measurements down to a concentration of 0·3 % of gum a mean particle weight of 220,000 ± 10 % has been obtained for Li, Na, K, Ag and Pb gum arabic salts in $N/2$ solutions of the alkali chlorides and $N/10$ $AgNO_3$ and $N/5$ $Pb(NO_3)_2$. With NaCl the weight in $N/10$ and $N/2$ solutions was 191,000 ± 2·2 % and 217,000 ± 1·5 % respectively. With $CaCl_2$ the weight was in both cases 245,000 ± 2 %. Below concentrations of 0·3 % the particle weight of Na gum in $N/10$ NaCl appears to rise to 245,000 at 0·15 %. It is thought that measurements of such small osmotic pressures ought to be confirmed by the ultra-centrifuge before they can be discussed profitably. [See also Abstract 545 (1935).] AUTHOR.

***4502. Motor-Driven Circulating Pump. G. Barr.** *Journ. Sci. Instruments*, 13. *pp.* 300–302, *Sept.*, 1936.—The pump is suitable for circulating gas rapidly at pressures not far from atmospheric, through a system of low resistance. A glass bell is enclosed in a vessel, which may be entirely of glass, containing mercury into which the bell dips: the spaces above and below the bell communicate with two pairs of valves of improved type. The bell is raised and lowered mechanically, pumping gas on both strokes. AUTHOR.

See also Abstract 4799.

ELASTICITY AND PLASTICITY.

4503. Local Distribution of Tensions in an Elastic Medium. F. Lévy. *Arch. des Sciences*, 18. *Suppt. No.* 2. *pp.* 86–95, *April–July*, 1936.—The Mohr diagram is introduced by a new and rapid method based on the power of a point on it with reference to the three fundamental circles defining the curvilinear triangle. A new method of construction is derived. The cones containing the normals to sections of equal normal, tangential and total absolute stress are derived. A representation, on a section of the unit circle, of the fundamental domain of the modular elliptic functions is given; it is derived from the Mohr diagram in the special case of pure shearing. T. L. M.

4504. Elasticity of Anistropic Bodies. M. S. Lechnitski. *Comptes Rendus*, 203. *pp.* 357–359, *Aug.* 3, 1936.—Equations are found for the displacement of a homogeneous body in equilibrium, with a symmetrical plane of elasticity, when subjected to plane deformations or plane tensions; also, equations for the deformation produced when normal tensions are applied along a particular contour. H. M. B.

4505. Compressibility of Electrolytic Solutions. C. Bachem. *Zeits. f. Physik,* 101. 9–10. *pp.* 541–577, 1936.—The electrostatic theory of electrolytes renders possible the statement of a formula for the dependence on concentration of the partial molar compressibility in dilute solutions. This relation was deduced by Gucker and proved for concentrated solutions of 0·5 *M.* and more. Through the development of an accurate method for the measurement of the velocity of sound it was possible to obtain the course of the molar compressibility up to concentrations of 0·05 *M.* A parallel light bundle proceeds parallel to the wave front in the sound wave and is collected to a system of stripes from whose distance apart the length of the sound waves can be very accurately determined. The sound generator is quartz-controlled. Results indicate that the apparent molar compressibility of the electrolyte is a linear function of the square root of the concentration. The inclinations of the curves agree with theory, and show the expected increase with the ionic charge of the electrolyte. In contradiction of the theory there remain the differences of the inclinations with different electrolytes of the same type of valency. The apparent molar compressibility of dissolved sugar varies linearly with the concentration in contradiction to a result of Gucker. J. J. S.

4506. Dependence of Constants of Elasticity of Palladium on the Content of Hydrogen. F. Krüger and H. Jungnitz. *Zeits. f. techn. Physik,* 17. 9. *pp.* 302–306, 1936.—Of the dependence of the elastic resistance characteristics of metals on their content of dissolved gases but little is known. Pd is specially suitable for their determiantion for it can be easily charged with H_2 to various degrees. Rupture diagrams were taken of Pd wires charged with H_2 to 13 different degrees. From these were calculated the modulus of elasticity, the limits of elasticity, and the resistance to rupture of the wires, in relation to the content of H_2, and curves were drawn. All these three constants show after a short rise a falling-off nearly proportional to the charge of H_2 up to the limits of saturation. The rise lies in the region of the pressure-concentration diagram of the H_2 in which the H_2 is taken up proportionally to the square root of the pressure and so in atomic form, whilst the decrease of the constants mentioned falls in that region in which the H_2 is received probably in molecular form and not built up into the lattice. J. J. S.

4507. Rotation in Plastic Media. B. Finzi. *Accad. Lincei, Atti,* 23. *pp.* 676–681, *May* 3, 1936.—Consider the movement in a medium both plastic and viscous, in which points describe circumferential paths which are coaxial, whilst all local conditions depend only on the time and axial distance. It is shown that the indefinite equations are linear, and identical with those for a fluid entirely viscous, if a constant double that for plasticity be added. In the case of stationary motion, if the medium can remain incompressible and forces external to the field are conservative, the general integral is identical with Cisotti's for a medium entirely viscous, but subject to non-uniform potential. W. A. R.

4508. Plastic Properites of Shellac. W. H. Gardner. *Physics,* 7. *pp.* 306–310, *Aug.,* 1936.—Properties of shellac, such as polymerisation, aggregation, condensation in the presence of chemicals, and adsorption of

water, which affect rheological measurements, are reviewed and discussed.
AUTHOR.

4509. Free Vibrations of a Circular Plate Supported at the Edge with a Frictional Moment at the Support. G. Ostroumow. *Techn. Phys., U.S.S.R.* 3. 7. *pp.* 583–598, 1936. *In German.*—The free symmetrical vibrations of a circular plate are calculated on the usual (Poisson-Kirchhoff) theory of the bending of thin plates, with the boundary conditions $u = 0$ (where u is the displacement) at the edge, and the bending moment per unit length on a section perpendicular to the radius vector r proportional to $\partial^2 u/\partial r \partial t$ at the edge. The solution of the "period" equation by graphical and approximate methods is discussed. The motion is damped, so that the solutions are complex. Asymptotic formulæ for the frequency and damping factor for the more rapid oscillations (higher overtones) are given. [See following Abstract.] S. G.

4510. Forced Vibrations of a Circular Plate Supported at the Edge. G. Ostroumow. *Techn. Phys., U.S.S.R.* 3. 7. *pp.* 599–603, 1936. *In German.*—The same theory (see preceding Abstract) is applied to the forced vibrations of a circular plate under a periodic exciting force concentrated at the centre. The equations are set out and general deductions made. If the frictional bending moment and $\partial^2 u/\partial r \partial t$ at the edge differ in the phase by 90°, so that there is no loss of energy, then the displacement differs in phase from the exciting force by 90° or 270°; the nodal lines are sharp, and there is a phase jump of 180°. In other cases, the displacements at different points all have different phases; in addition to the standing wave there is also a progressive wave; and there are no nodal lines. But if the previous case is approached the appearance will probably suggest that of the previous case. S. G.

***4511. Stress and Deflection of Helical Springs. R. F. Vogt.** *A.S.M.E., Trans.* 58. *pp.* 467–475, *Aug.*, 1936.—The old conventional formulæ for determining stresses in helical springs are unsatisfactory and the complicated equations offered in the past few years by different authors are too cumbersome, especially when the curvature of the bar, pitch angle, and bending stress for correct stress determination are considered. If all of the stress-influencing factors are considered, the equations introduced in recent years become so cumbersome that designers are tempted to sacrifice accuracy for convenience by neglecting these factors. Such short cuts for evading complications are unsatisfactory because the range of error thus introduced is not fully known or realised. Because of these conditions, new stress formulæ for calculating stresses in helical springs are developed and presented in this paper. These formulæ are for use in determining the stresses in helical springs of circular-bar and rectangular-bar cross-section. They include the proper consideration of bar curvature, pitch angle and bending stress, but are nevertheless extremely simple. Design calculations for tension and compression helical springs are made to show the application of the formulæ developed. AUTHOR.

***4512. Experimental Method for the Solution of Plane Stress Problems. (Miss) L. Chitty and A. J. S. Pippard.** *Roy. Soc., Proc.* 156*A*. *pp.* 518–537, *Sept.* 1, 1936.—A model of the plate to be analysed, cut from thin rubber sheeting which has a linear stress-strain law, is floated on a shallow bath of mercury to maintain its planarity, and is held and loaded as prescribed by the conditions of the problem. The displacements under load of points marked on the surface are measured by a micrometer microscope, and from a systematic exploration of these in prescribed directions displacement-direction curves covering the whole surface are plotted; the slopes of these curves at any point can be measured, and since the elastic properties of the rubber are known the stress can be calculated. If the Poisson's ratios of the rubber model and the material of the specimen do not differ widely results can be interpreted directly. The method is illustrated by the problem of a disc supported at a central hub and loaded radially over 10° of its circumference. N. M. B.

***4513. Apparatus and Measuring Methods for the Mechanics of Solids, Liquids and Gases. Part I. H. Ebert.** *Die Physik*, 4. 3. *pp*. 93–106, 1936.—This paper is essentially a survey of the subject, and has a very extensive Bibliography of the papers relating to the measurements discussed. The topics dealt with include elastic deformation, density and " quantity " (which includes such details as Reynolds' and Froude's numbers) and also pressure, including the measurement of high and low pressures, pressure and vacuum pumps and vacuum apparatus. G. E. B.

See also Abstracts **4494, 4498, 4562, 4803, 4919.**

GRAVITATION.

***4514. Dependence of Foucault Pendulum Oscillations on Latitude. R. Weinzierl and O. Krummacher.** *Zeits. f. Instrumentenk*, 56. *pp*. 332–336, *Aug*., 1936.—By means of a frictional disc the rate of rotation of another larger disc is decreased. The planes of the discs are perpendicular to one another but their radii are inclined at different angles. The horizontal plate rotates underneath the swinging Foucault pendulum and about a perpendicular axis. The details of the apparatus and its principle of action are described. R. S. R.

4515. Gravity Measurements in East Africa. E. C. Bullard. *Roy. Soc., Phil. Trans*. 235*A*. *pp*. 445–531, *Aug*. 10, 1936.

See also Abstract **4591.**

HYDRODYNAMICS AND AERODYNAMICS.

4516. Aerofoil Theory. B. Eck. *Ingenieur-Archiv*, 7. *pp*. 203–206, *June*, 1936.—Formulæ for transformation of induced drag and lift from one aspect ratio to another, when the incidence is supposed constant. Connection between lift and drag coefficients for a constant incidence and variable aspect ratio. S. G.

4517. Liquid Flow. B. Caldonazzo. *Accad. Lincei, Atti*, 23. *pp*. 322–328, *March* 1, 1936.—The problem of the flow from a source at the centre of an enclosure in the form of an arc of a circle is worked out, and includes both the motion within the enclosure and the field outside thereof. W. A. R.

4518. Liquid Motion. C. Agostinelli. *Accad. Lincei, Atti*, 23. *pp*. 317–322, *March* 1, 1936.—If motion is generated by a source at the back of one face of a rectilinear profile, there is a stationary solution of the problem with the production of two vortices symmetrically situated with respect to the axis of the profile. W. A. R.

4519. Helical Vortices. C. Agostinelli. *Accad. Lincei, Atti*, 23. *pp*. 670–676, *May* 3, 1936.—The author first gives the conditions for the integration of Euler's hydrodynamic equations. These are applied to determine the character of a helical vortex with a constant component along the z-axis. A non-rotational solution of the equation of Euler is obtained on the outside of a cylindrical vortex of radius r. W. A. R.

4520. Trajectories of Perfect Heterogeneous Fluids. É. Merlin. *Comptes Rendus*, 202. *pp*. 2130–2132, *June* 29, 1936.—The author considers a perfect heterogeneous fluid under a force per unit of mass derived from a potential varying with time, such that density and velocity at a given point are supposed independent of the time, but pressure may be so dependent. Auxiliary surfaces are defined and the equations derived from which the trajectories, velocity, and the pressure and potential capable of producing the motion are to be found. [See following Abstract.] T. L. M.

4521. Trajectories of Perfect Heterogeneous Fluids. É. Merlin. *Comptes Rendus*, 203. *pp*. 297–299, *July* 27, 1936.—A special case of the author's theory [see preceding Abstract] of the motion of heterogeneous perfect fluids is worked out, in which the trajectories are helices. The case may be applied to the shapes of spiral nebulæ. G. C. McV.

4522. Theory of the Kármán Vortex Street. C. Schmieden. *Ingenieur-Archiv*, 7. *pp*. 215–221, *Aug*., 1936.—The paper deals mathematically with the stability of a Kármán vortex street, consisting of two parallel rows of line vortices of opposite rotations in an inviscid fluid, with the vortices in one row opposite the lines halfway between two consecutive vortices in the other row. It is known that there is instability for infinitesimal disturbances unless $\sinh 2\pi h/b = 1$. ($2h =$ the distance between the rows, $b =$ distance between two consecutive vortices in one row). The author points out that even if this condition is fulfilled, there must be instability for certain finite disturbances—in particular, for a disturbance in which initially every alternate vortex in one row is moved the same distance perpendicular to the row, whilst the positions of all other vortices are unchanged. The instability will be weak. The full discussion of the disturbed motion is reserved for a later paper. In this paper the equations for a finite disturbance are considered and transformed, when the displacements of the vortices are the same for all the vortices in any one of four sets, the displacements of each of the four sets being different, and the sets consisting of alternate vortices in each of the two rows. S. G.

4523. Jet of Compressible Fluid. C. Jacob. *Comptes Rendus*, 203. *pp*. 423–425, *Aug*. 18, 1936.—The method of Tchapliguine [*Annales scientifiques de Moscou*, 21 *p*. 1 (1904)] is applied to calculate the steady two-dimensional flow, with free stream-lines, of an inviscid compressible fluid at subsonic speeds which flows, from infinity, through a slit symmetrically situated in a wall whose trace is two straight lines at angle 2μ, the case $\mu = \frac{1}{2}\pi$ having been previously considered by Tchapliguine. The velocity potential and stream function are given (in the notation of a previous paper by the author [see Abstract 3919 (1933)], certain properties of the functions occurring are set out, and limits derived for the coefficient of contraction. S. G.

4524. Wave Resistance of a Ship Moving on the Surface of Water of Finite Depth. L. Sretenskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 7. *pp*. 265–267, 1936. *In French*.—The paper gives a *résumé* of researches of which a full account will be published in the Transactions of the Joukowski Central Hydrodynamical Institute. J. H. Michell [see Abstract 904 (1898)] calculated the wave resistance for infinite depth with an idealised ship form (in which the inclination of the surface to the plane of symmetry was taken to be everywhere small). The results are here generalised to the case of an unlimited sheet of water of finite depth, and then to the case of a ship moving on the surface of an infinitely long canal of finite depth and finite breadth. S. G.

4525. Flow through a Lattice Formed with Blades in the Form of Circular Arcs of Small Curvature. P. A. Walter. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 8. *pp.* 321–323, 1936. *In German.*—An approximate method of finding the flow with a smooth entry and smooth exit through a staggered row of circular-arc blades has been given by Weinig. (Smooth entry and smooth exit denote that the points on the blades where the stream divides coincide with the leading and trailing edges.) In this paper it is shown how all possible flows with a given flux may be found. S. G.

4526. Distribution of Mean Velocity in Turbulent Parallel Flow. V. Gavrilenko. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 9. *pp.* 371–376, 1936. *In German.*—The author makes, without suggesting any justification, the following assumptions for calculating the mean velocity in turbulent flow through a pipe. The velocity gradient at any point P is the vector sum of contributions due to each element ds of the wetted circumference, the contribution of ds being along the line from ds to P, and proportional to the projection of ds on a plane at right angles to that line and inversely proportional to the square of the distance between P and ds. (The physical constants of the system and hydraulic character of the wetted surface—density, viscosity, Reynolds number, intensity of wall friction—also enter). The consequences of the assumptions are worked out for a circular pipe, for two-dimensional flow between parallel walls, and (with complete neglect of the secondary flow) for a rectangular pipe. S. G.

4527. Theory of Turbulence. K. Takahasi. *Geophys. Mag., Toyko,* 10. *pp.* 1–12, *Aug.*, 1936. *In English.*—In analogy with the theory of Brownian movement, the author writes for the equation of motion of a fluid element in turbulent flow $d\,\mathbf{q}/dt = \mathbf{F} - \rho^{-1}\,\mathrm{grad}\,P - \mu\,\mathbf{q} + \mathbf{f}$, where d/dt is differentiation following the motion of the fluid, $\mathbf{q}$ is the velocity, $\mathbf{F}$ the external force per unit mass, ρ the density, P the pressure, μ a constant. μ and $\mathbf{f}$ are small, but $\mathbf{f}/\mu$ is moderate, and $\mathbf{f}$ has the character of an irregular external force and is such that its mean value is zero; it is statistically independent of P, $\mathbf{q}$ and $\mathbf{F}$, the correlation between different components is zero, the correlation between values at different times and different positions is zero, and $(\int_t^{t+\Delta t} \mathbf{f}_i\, dt)^2/\Delta t \to Q_i\,(t)$ as $\Delta t \to 0$ ($i = x, y, z$). For homogeneous, isotropic turbulence $Q_x = Q_y = Q_z = Q$ = constant. When the external force and pressure gradient are zero, the author deduces that $\overline{q_i q_j} = 0$ for $i \neq j$ and $= Q/2\mu$ for $i = j$; the velocity distribution follows Maxwell's law; the coefficient of correlation between the velocities of a fluid element at the beginning and end of an interval t is $e^{-\mu t}$; in turbulent diffusion the mean square of the deviation of a particle from its mean position is $\mu^{-2}Qt - \mu^{-3}Q(1 - e^{-\mu t})$; after a sufficient time the statistical equation of diffusion is $\partial\phi/\partial t = \mu^{-\prime}\,\overline{q^2}\,\nabla^2\phi$, or if $\mu^{-1}\,\overline{q^2}$ is not constant, $\partial\phi/\partial t = \Sigma\,\partial\,(\mu^{-1}\,\overline{q^2}\,\partial\phi/\partial x)/\partial x$. The equation for mean flow with isotropic turbulence is then given as $d\,\overline{q_i}/dt = -\rho^{-1}\,\mathrm{grad}_i\,(P + \rho\,\overline{q^2}) + F_i + \Sigma\,\partial\,(\frac{1}{2}\mu^2\,Q\,\partial\,\overline{q_i}/\partial x)/\partial x$. Modifications for anisotropic turbulence are mentioned, and then the results are compared with experiments on the scattering of balloons by Sutton and by Saito and Yositake. It is deduced that in Sutton's experiments, in a wind of velocity u, $\sqrt{\overline{(q_i^2)}}/u = 0{\cdot}08$; and in the Japanese experiments $\sigma \propto ut$ for small t

and as $(ut)^{1/2}$ for large t. Estimates of the values of μ for the atmosphere give values of the order of 10^{-3} or 10^{-4}. S. G.

4528. Fluid Flow in the Inlet Length of a Straight Pipe of Circular or Annular Section. W. Müller. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp*. 227–238, *Aug*., 1936.—This paper contains the solution, by the use of series of Bessel functions, of the problem of the variable flow, parallel to the axis, of a viscous incompressible fluid in an infinitely long straight pipe of circular or annular section (*i.e.* bounded by two concentric cylinders) with an initial distribution of velocity the same over all cross-sections and symmetrical about the axis, under the influence of a pressure gradient which is a given function of the time and is constant at any instant. General formulæ, in the form of infinite series, are given for the velocity in the general case for a circular pipe; and for both a circular pipe and an annular pipe when the initial velocity is constant and the pressure gradient variable, with the pressure gradient proportional to exp. $(-\alpha^2\tau)$ or to sin $\beta\tau$ (α and β constants, τ = time) in a circular pipe specially considered in the latter case. The case of constant pressure gradient and constant initial velocity is specially considered in detail; and some numerical values are worked out, and shown in tables and graphs, for an initial velocity equal to the average velocity over a section in the final flow in a circular pipe and in an annular pipe in which the ratio of the diameters of the outer and inner cylinders is 2 : 1. S. G.

See also Abstracts 4507, 4773.

KINETIC THEORY OF MATTER.

4529. Kinetic Theory Applied to the Evaporation and Sublimation of Gases. H. A. Giddings and P. D. Crout. *J. Math. Phys.* 15. *pp*. 124–178, *June*, 1936.—The methods used in an earlier paper [see Abstract 1999 (1936)] for monatomic gases are extended to polyatomic gases to give similar results. Tables and curves suitable for practical use are obtained. R. W. P.

4530. Two Deductions from Bernoulli's Theorem. B. Kries. *Zeits f. Physik*, 101. 9–10. *p*. 657, 1936.—It is concluded from application of Bernoulli's theorem that if a cylinder containing gas under pressure is rotated so that the velocity of the side wall is equal to the most probable velocity, a, of the gas molecules, the walls of the cylinder receive no radial pressure. Further, since a is a function of the temperature and independent of pressure the above conclusion holds at any pressure. J. E. K.

4531. Collision Frequency in Solutions. K. S. G. Doss. *Indian Acad. Sci., Proc.* 4A. *pp*. 23–26, *July*, 1936.—An interpretation of a collision in solution is given on the basis of Wheeler's theory of liquids. The expressions for the collision frequencies based on this theory work out to be similar to those found by other methods and used with success in the interpretation of kinetics of reaction in solution. AUTHOR.

See also Abstracts 4447, 4513, 4709, 4769.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***4532. Apparatus for Measuring Solid Angles. A. Aubertin.** *Rev. d'Optique*, 15. *pp*. 263–271, *Aug*., 1936.—The principle of the apparatus and a description of its construction, and its method of use are given. A solid angle ω is measured in terms of an arc rotating on a divided circle. The apparatus can also be used as a planimeter. R. S. R.

***4533. Errors in Fractions of a Circle. F. Hauer.** *Zeits. f. Instrumentenk.* 56. *pp.* 309–321, *Aug.*, 1936.—Heuvelink's formulæ for the general case for the determination of errors of fractions of a circle are first derived. These can be simplified to find the amplitude and phase constant of the errors of the partial circles if the necessary regular subdivision of the circular distances of the half circumference of the circle is carried out. These considerations are investigated. Two practical examples are taken in which the instruments have the degrees divided into sixths and twelfths. The exact and approximate methods give almost identical results. The relations are generalised in a table for fractions of 5′, 10′, 20′ and 30′. Conclusions are drawn regarding this method of operation. R. S. R.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4534. Potential Functions Related to Groups of Circular Cylinders. R. C. J. Howland and B. W. McMullen. *Cambridge Phil. Soc., Proc.* 32. *pp.* 402–415, *July*, 1936.—The methods of an earlier paper [see Abstract 3529 (1934)] are extended to other cases. Two-dimensional configurations are considered in which the boundaries are a group of equal circles together with, in some cases, one or more circles on straight lines. With each of the equal circles is associated a rectangular coordinate system and a polar coordinate system and the boundaries, boundary conditions, and infinity conditions must be invariant under a group of transformations in which each coordinate system and the corresponding circle transform into another system and another circle of the equal set. Potential functions are then constructed which are invariant under the same group and expansions of these functions are found about the centre of any one of the circles. If the boundary conditions on this circle are now satisfied in terms of the functions, the conditions on the other circles will be satisfied automatically. When these are additional boundaries the functions must be constructed so that the conditions on these are satisfied in advance. R. S. R.

4535. Significance Tests. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 32. *pp.* 416–445, *July*, 1936.—The following subjects are treated and discussed in the paper: (1) general remarks on significance tests; (2) assessments of the prior probability; (3) contingency; and (4) representation of a set of observations by assigned functions. Examples are given of simple sampling, a test of randomness, and of an approximation by assigned functions. [See also Abstract 2395 (1935).] R. S. R.

4536. Significance and Evaluation of the Total Type Scale and its Applications. K. Kitagawa. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 323–330, *July*, 1936. *In French.*—Results sought recently relating to electric discharge and water flow led to the idea that there is a new significance of the total type scale of dispersion. It is expressed by a formula which is very close when account is taken of its validity. One can obtain from it the value of the observation, and the habit of the observer. An extension in the form of an ellipse or ellipsoid is made of the probability with notable practical applications. R. S. R.

4537. Magnetic Formulæ in M.K.S. Units. A. E. Kennelly. *Am. Phil. Soc., Proc.* 76. 3. *pp.* 343–376, 1936.—Electrical engineering literature employs the practical ohm-volt-ampere series of electromagnetic units so extensively that it might be often supposed to have been written in connection with the Giorgi M.K.S. system of units. The adoption of the Giorgi system by the International Electrotechnical Commission in June, 1935, therefore, introduces no change in the current literature of the voltaic circuit or of the continuous current electrical engineering circuit. Owing, however, to the action of the International Electrical Congress of Chicago in 1893, it is an almost universal custom to employ the C.G.S. magnetic system of units in the literature of the magnetic circuit for engineers. Electrotechnical formulæ for the magnetic circuit in M.K.S. units, together with arithmetical examples of their use, are given in the hope of aiding students to apply the M.K.S. system in magnetic-circuit computations. A number of these formulæ are independent of the question of "rationalisation." The formulæ which are affected by "rationalisation" are presented in both rationalised and unrationalised, or classical, form in parallel columns, so that the reader may choose between these two forms. AUTHOR.

4538. Relations between and Rationalisation of Electrical Units. G. Darrieus. *Soc. Franç. Élect., Bull.* 6. *pp.* 959–971, *Sept.*, 1936.—The author shows that the formation of a "rationalised" system of electrical units, far from being an innovation, is nearly realised by the units already in general use. The formation of a complete rational system is effected by renouncing a few magnitudes of double usage, without introducing any new or unfamiliar unit, and while leaving unchanged the usual form of nearly all the relations between units. At the same time, the practical equations of electrotechnics are brought into conformity with those of theoretical physics. Instead of the classic definition of the magnetic field, that adopted is m.m.f. per unit length. The expression of relations then conforms to that most used in physics and electrical engineering and is adapted to the units of the Giorgi system. A diagram is presented showing the correspondence between the electrical and magnetic quantities in the rationalised system and having an important significance in relation to modern speculations on the structure of the field, the quantum theory and the constituents of matter. R. E. N.

***4539. Time-Lag in a Control System. A. Callender, D. R. Hartree and A. Porter.** *Roy. Soc., Phil. Trans.* 235*A*. *pp.* 415–444, *July* 21, 1936.—A theoretical study is made of the operation of gear used to control some physical quantity which is subject to random disturbances when the operation of the gear is determined solely by the behaviour of the quantity to be controlled, and when there is a time-lag between this behaviour and the effect of the control. Solutions of the control equations are derived for certain specified conditions, and ranges of the values of the parameters involved, suitable for stable control, are given. Practical methods of control in accordance with the theory are outlined. L. E.

***4540. Adjustment of the Slide Rule to Present Numerical Requirements. A. Rohrberg.** *Zeits. f. Instrumentenk.* 56. *pp.* 322–328, *Aug.*, 1936.—The author describes the principles of the older standard and more recent specialised forms of slide rule for particular purposes. The method of operation for squares, square roots, cubes, and cube roots and the use of trigonometric scales are described and the means adopted for increasing the accuracy of operation. R. S. R.

***4541. Construction and Operation of a Model Differential Analyser. D. R. Hartree and A. Porter.** *Manchester Lit. Soc., Mem.* 79. *pp.* 51–73, 1934–1935.—This paper gives a detailed account of a simplified form of the original "differential analyser" designed and constructed by Bush. The analyser consists of a number of component units which may be interconnected in different ways, *viz.*, input tables, integrators, adding units, and output table. The fundamental components are the integrators, with which are associated mechanical torque amplifiers which eliminate slip between the integrating wheel and disc. The input tables are units whereby certain information concerning the differential equation under investigation, in the form of functional relationships between variables occurring in it, is transmitted to the machine. The adding unit consists of a differential gear system so arranged that the angular rotation of one shaft connected to it is the sum of the rotations of two other shafts. The final solution of the equation is drawn in the form of a curve on the output table, which is similar in principle and essential details of construction to the input tables. J. S. C.

***4542. Automatic Curve Follower. H. L. Hazen, J. J. Jaeger, and G. S. Brown.** *Rev. Sci. Instruments*, 7. *pp.* 353–357, *Sept.*, 1936.—In certain mechanical devices, *e.g.*, calculating machines such as the differential analyser [see preceding Abstract] and machines for cutting cams and templates, it is desired that the displacement of a member of the device be related by some arbitrary function to the displacement of a second member. The automatic curve follower is an application of a high-speed servo motor to such a device designed to convert the ordinates of a curve into the angular displacement of a shaft. The curve to be followed is the boundary between a highly reflecting surface and a blackened light-absorbing surface and is placed on a table which is continuously displaced along ways in accordance with the dictates of the independent variable. The output shaft, whose angular displacement should correspond at any instant to the value of the dependent variable, drives a screw whose axis is parallel to the axis of ordinates. This screw controls the motion of a carriage which carries a lamp, photo-cell and slit through which the curve is illuminated. The photo-cell current is amplified and operates the servo motor, which in turn operates the output shaft through a mechanical torque amplifier. The paper discusses the dynamic design, errors and performance of the apparatus. J. S. C.

See also Abstracts 4497, 4532, 4533, 4544.

MECHANICS, CLASSICAL.

4543. Transformation Preserving the Canonical Equations of Motion. A. Datzeff. *Comptes Rendus*, 203. *pp.* 300–302, *July* 27, 1936.—A certain transformation due to Levi-Civita which preserves the form of the Lagrangian equations of motion of a dynamical system is shown to preserve the form of the Hamiltonian equations also. The analogous transformation in quantum mechanics is worked out. G. C. McV.

4544. Velocity and Energy of Broken Pieces of Spherical Bodies. S. Suzuki and H. Nagasima. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 319–322, *July*, 1936. *In English.*—Balls made of sealing-wax, chalk-powder, plaster of Paris or " Castone " plaster are broken by three methods; *i.e.*, the explosion of bursting powder, the falling of a ball upon a massive iron plate, and the collision of two balls hung like pendulums. The broken pieces can be grouped into large and small ones. Concerning the former, the following properties are recognised :—The velocity of each broken piece tends to decrease with the increase of mass, while the kinetic energy tends to increase. The energy expended in breaking balls, when dropped upon the iron plate, is as follows : Chalk-powder, 97–98 % ; sealing-wax, 70–80 % ; Castone plaster, about 90 % of the total kinetic energy. In the case of explosion, the broken pieces rotate at remarkable speed, as they fly through the air. Some, for instance, even make 20 rotations per sec. Experiments to find the strain-distribution at the instant of breakage were tried. AUTHORS.

MECHANICS, QUANTUM.

4545. Space Quantisation in Time Varying Magnetic Fields. L. Motz and M. E. Rose. *Phys. Rev.* 50. *pp.* 348–355, *Aug.* 15, 1936.—The transitions between states of different space quantisation which take place when an atom is passed through a weak inhomogeneous magnetic field are calculated by approximate methods taking into account the coupling between the nucleus and the orbital electrons. Two types of field are considered, namely, the field introduced by Majorana and the one introduced by Güttinger. For the Majorana field a discussion of the cases I arbitrary $J = \frac{1}{2}$, J arbitrary $I = \frac{1}{2}$, and I and J arbitrary with explicit application to the nitrogen atom is given. For the Güttinger field the general equations are set up for a field of any strength and are then applied to the case $I = J = \frac{1}{2}$. AUTHORS.

4546. Importance of the New Quantum Theory for Chemistry. E. Hückel. *Zeits. f. Elektrochem.* 42. *pp.* 657–662, *Sept.*, 1936.—A résumé of the applications of physics to chemical problems particularly those concerned with atomic structure and involving electromagnetic fields. Progress during the past 10 years is described, and the present situation reviewed in detail. The older quantum theory is then discussed together with the electronic theory of valency, after which the significance of the new quantum theory is treated comprehensively. This latest development embraces a physical-mathematical system which includes all processes that involve material particles moving with velocities up to values comparable with the velocity of light. For the first time the interaction between matter and radiation has been dealt with mathematically and has enabled all the reactions of matter to be described. As a result all chemical problems can be referred to fundamental physical laws, and treated by the methods of wave mechanics. Experimental progress due to the new theory is described, such as the determination of atomic arrangements in the molecule by the electron interference method, the evaluation of valency forces, and atomic distances, and the existence of free radicals. H. H. Ho.

4547. Wave Matrices, and Properties of the Wave Equation. S. R. Milner. *Roy. Soc., Proc.* 157*A*. *pp.* 1–27, *Oct.* 1, 1936.—There are reasons for believing that the "wave matrices" used in the first order wave equation should be defined by the condition $E_\alpha^{-1}E_\beta = -E_\beta^{-1}E_\alpha$, rather than by $E_\alpha E_\beta = -E_\beta E_\alpha$, the equation on which they are based in standard theory. It is shown that the new definition enables the matrices, and the "wave sets" formed from them, to be developed into closed groups, and the relations between them, such as the numerous "wave set identities," to be classified and made amenable to a complete treatment, which cannot be done on the old definition. A further consequence is that the wave equation, in its general mathematical form, finds place in it for six terms, as against the five occurring in Dirac's equation. The properties of the matrices are applied also to draw certain inferences about the mathematical form of the accurate solution of the wave equation, which are tested by examining in detail the known solution for the H atom. AUTHOR.

4548. Interaction of Heavy Particles. D. Iwanenko and A. Sokolow. *Zeits. f. Physik*, 102. 1–2. *pp*. 119–131, 1936.—The same forces which lead to the creation of an electron and a neutrino in β-decay, also produce, in second approximation, forces between neutron and proton and, to a smaller extent, between two protons or two neutrons. The calculation of the magnitude of these forces involves difficulties, because the involved integrals diverge. One can, however, discuss their dependence on the distance between the heavy particles. In order to make the range of the forces between the heavy particles of the order 10^{-13} cm., which would fit the range observed in nuclei, it is necessary to assume that the elementary law of force leading to β-decay contains the velocity of the emitted particles in the third power. The connection with the neutrino theory of light is discussed. R. P.

See also Abstracts 4543, 4728.

RELATIVITY AND ETHER.

***4549. Lorentz Contraction of Fluids. L. Courvoisier.** *Zeits. f. Physik*, 101. 7–8. *pp*. 422–436, 1936.—Five series of observations of a level floating on mercury, at different seasons, show variations in the period of a sidereal day, analogous to those already observed with levels attached to solid supports [see Abstract 1055 (1936)]. The range of variation is less than that calculated from the theory of a Lorentz contraction of the earth ; this difference is thought real but not explained. The plumb line is in general not normal to the free surface of the fluid deformed by the Lorentz contraction. [See following Abstract.] T. L. M.

***4550. Determination of Lorentz Contraction by Rotatable Level Apparatus. L. Courvoisier.** *Zeits. f. Physik*, 101. 7–8. *pp*. 437–446, 1936.—Experimental arrangements for enabling the author's level apparatus, both floating and on solid support, to be rotated about a vertical axis, are described. Observations were made with each type at three different sidereal times. The differences of the readings confirm the author's computed Lorentz contraction based on an absolute velocity of about 400 km./sec. : the experimental velocities are 446, 380 km./sec. for floating level and solid support respectively. [See preceding Abstract.] T. L. M.

See also Abstract 4436.

SOLUTION.

4551. Solubility of Thorium in Mercury. W. G. Parks and G. E. Prime. *Am. Chem. Soc., J.* 58. *pp*. 1413–1414, *Aug*., 1936.—Methods of preparing amalgams of Th in Hg are described. The solubility given, 0·0154 % by weight (0·0136 %, atomic) at 25° C., is considered an upper limit. L. V. C.

4552. Solubility of Non-Electrolytes. Part III. Entropy of Hydration. J. A. V. Butler and W. S. Reid. *Chem. Soc., J. pp*. 1171–1173, *Aug*., 1936.—The entropies of hydration of a number of substances are calculated from the heats and free energies of hydration, or determined from the temperature coefficient of the free energy. This quantity is little influenced by the constitution of the solute molecule, but it appears to be mainly dependent on its size. It is suggested that the solute molecules have a disorientating effect on water, increasing with their size, which gives the solute an abnormally low partial entropy in the solution. [For Part II see Abstract 3780 (1935).] AUTHORS.

See also Abstract 4470.

SURFACE TENSION AND COHESION.

***4553. Resistance of Solid Surfaces to Wetting by Water. R. N. Wenzel.** *Indust. and Engin. Chem.* 28. *pp.* 988–994, *Aug.*, 1936.—The author discusses critically the application of wetting theory to the study of water-repelling agents. It is inherent in the fundamental theory of wetting action that the wetting properties of a solid substance should be directly proportional to the roughness of the surface wetted. This fact does not appear to have been clearly recognised. Variations in the wetting properties of a solid, when encountered in experimental data, have usually been attributed to some form of surface contamination. An improved apparatus for comparing the wetting characteristics of solid surfaces is described. The method applies the tilting plate principle for the direct measurement of contact angles. This method is capable of accurate and reproducible results, provided the readings are taken dynamically, and should have a wide range of applicability. Contact-angle measurements on a number of waxes, metallic soaps, gums, and certain related compounds are reported. A technique has been devised for comparing the water repellency imparted by dilute waterproofing baths to paper and textile surfaces ; for this purpose, contact-angle measurements have the advantage that they are not influenced by the mechanical strength and uniformity of the fabric. The large amount of surface per unit area of fibrous materials plays a prominent part in the effectiveness of water-repelling applications, as does any tendency of the deposit itself to give granular or microcrystalline, rather than smooth, coatings. H. H. Ho.

4554. Wetting Characteristics of Solids of Low Surface Tension such as Talc, Waxes and Resins. F. E. Bartell and H. H. Zuidema. *Am. Chem. Soc., J.* 58. *pp.* 1449–1454, *Aug.*, 1936.—The wetting characteristics of talc and of a number of waxes and resins have been studied by measurements of the contact angles formed by small drops of liquid on these solids. Both water and organic liquids (of high surface tension) form contact angles on these solids, thus indicating that the surface tension of these solids is low. Soft solids of low surface tension are wetted less readily by liquids than are hard solids which possess a higher surface tension. On talc, accurate measurements could be made of interfacial contact angles as well as of contact angles in air both with water and with organic liquids. This made possible the experimental testing of the Bartell-Osterhof equation relating adhesion tension and interfacial contact angles. This equation was found to hold. AUTHORS.

***4555. Ageing of Surfaces of Solutions. Parts I and II. K. S. G. Doss and B. S. Rao.** *Indian Acad. Sci., Proc.* 4*A*. *pp.* 11–16 *and* 97–107, *July*, 1936.—In Part I an automatic device for the construction of quartz helical springs is described. The surface tension of toluene is determined by the ring method employing a quartz helical spring for measuring the maximum pull. The effect of time on surface tension of several liquids is studied and the results discussed. It is shown that the ring method is not suitable for the measurement of variation of surface tension with time. In Part II a new application of the Langmuir-Adam surface pressure technique is made in the study of ageing of surface of solutions. It is sound that a fresh surface of a solution of benzopurpurin exhibits a fall of surface tension with time. If by suitable methods, an overcrowding (by solute molecules) of the surface is brought about, such a surface exhibits a rise of surface tension in time. The molecules accumulated at the surface are shown to exhibit a reluctance to get into solution; it has therefore been possible to measure the rate of accumulation and has been found to be very slow. The slowness is best accounted for on the basis of activated accumulation. The postulation of activation is further helpful in understanding (*a*) the time variation of surface tension, (*b*) the high temperature coefficient and (*c*) the manifestation of surface pressure. The results of the present investigation are extremely helpful in measuring the efficacy of a substance as the stabiliser of foam. Several new lines of investigation which have opened up are briefly indicated. AUTHORS.

4556. Free and Total Surface Energies and Related Quantities. A. Ferguson and S. J. Kennedy. *Faraday Soc., Trans.* 32. *pp.* 1474–1481, *Sept.*, 1936.—The main purpose of this paper is to set out data culled from various publications with a view to the computation and discussion of the values of the free and total surface energies e_0 and E_0 of supercooled liquids at the absolute zero, their dependence on constitution, and their relation to other physical constants. Values of γ_0, n and p in the equations $\gamma = \gamma_0\ (1-m)^n$ and $\gamma = C\ (\rho_L-\rho_v)^p$, and values of $e_0 = E_0$ are given for 42 substances representing very varied types of organic liquid. In a tentative discussion it is shown how the definition of the parachor P as $MC^{1/p}$ alters the value of P as compared with the value given by the fourth power law. Empirical relations $e_0 = 0{\cdot}811\ \theta_c V_c^{0{\cdot}176}$ and $\gamma_o = 3{\cdot}12\ \theta_c V_c^{-0{\cdot}55}$ (V_c = critical molecular volume) are derived and tested. Values of P based on the derived relation $P = 0{\cdot}324\ \theta_c^{1/4} V_c^{7/8}$ are shown to be in reasonably good agreement with Sugden's values. Finally a tentative attempt is made to investigate the relation between chemical constitution and the values of γ_o and e_o. P. H. B.

4557. Rearrangement of Molecules in Plastic Monomolecular Films. W. D. Harkins, E. F. Carman and H. E. Ries. *Am. Chem. Soc., J.* 58. *pp.* 1377–1383, *Aug.*, 1936.—The solid monomolecular films of four of the six five-ring compounds considered in this paper have been found to give a behaviour not previously exhibited, at least not in anything like this high degree. That is, if kept at constant area the pressure almost entirely disappears due to a shrinkage of the film. The behaviour is more nearly analogous to that of a wax than to a crystalline solid. Thus for these films the initial pressure seems to be of much more significance than the final pressure. The initial and final pressures of all of the films and the surface potentials, are graphically recorded. At film pressures of eight dynes per cm. the apparent thickness of the film varies from 14 to 17 Å. for the various compounds, which is about the thickness to be expected if molecules with five rings stand on end. AUTHORS.

See also Abstracts **4694, 4832.**

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

4558. Apparent Lunar Effect in Time Determinations. S. Kawasaki. *Roy. Astron. Soc., M.N.* 96. *pp.* 818–824, *June*, 1936.—Loomis and Stetson [see Abstract 2877 (1935)] found from time-signal comparisons a variation of longitude between Europe and North America with the moon's hour-angle, subject to inversion with change of the moon's declination. The author shows that the monthly means of their data present a systematic annual variation: no explanation of this is attempted. The use of the moon's hour-angle and declination at 0 h. U.T. for Greenwich meridian introduces a selective seasonal effect, as sidereal time advances on solar time. The apparent lunar effect would therefore be spurious. T. L. M.

***4559. Reception of Rhythmic Time Signals by Coincidences. E. Hunziker.** *Bull. géodésique, No.* 50. *pp.* 173–200, *April–May–June,* 1936.—In the method discussed the clock interrupts reception for a fraction of each second; a certain number of the rhythmic signals are thus cut out. Where the clock is correctly rated the return occurs at the same fraction of a second each minute. It is shown that more accuracy is obtained by using a clock rated so that there are not 60 sec. between coincidences. The best distribution and correct rating for this purpose are discussed for sidereal and mean time. For mean time there should be 58·8 sec. between coincidences, the clock losing 28·896 sec. per day. The adaptation of a ship's chronometer for this purpose is described and the observations fully discussed. The method has the advantages of simple equipment, observations and reduction; but the clock must give the seconds with great regularity and the observer must accustom himself to detecting the first return of the signal at each coincidence; the error in good listening conditions will then not exceed a few thousandths of 1 sec. Arrangements for cutting out parasitic sounds from the clock are given in an Appendix. T. L. M.

***4560. Time Marking with a Kathode-Ray Oscillograph. G. A. Whipple.** *Journ. Sci. Instruments,* 13. *pp.* 291–295, *Sept.,* 1936.—A method is described by means of which time-intervals may be accurately impressed on rapidly moving films. The method will allow of time-intervals down to less than 10^{-5} sec. to be clearly marked, the regularity being independent of the amplitude or wave-form of the constant frequency source. A device is further described by means of which long time-intervals may be rapidly estimated by emphasising the time marks at selected intervals. AUTHOR.

VACUA, HIGH.

See Abstract 4513.

VISCOSITY, FRICTION AND LUBRICATION.

4561. Viscosity of Suspensions and Solutions. Part VII. R. Simha. *Kolloid Zeits.* 76. *pp.* 16–19, *July,* 1936.—The present papers deal mathematically with the viscosity of spherical suspensions, with reference to Poiseuille streaming. [For Part VI see Abstract 3057 (1936).] J. K.

4562. Analysis of Results of Experiments on Elasto-Viscous Bodies. A. Gemant. *Physics,* 7. *pp.* 311–317, *Aug.,* 1936.—An attempt is made to develop a general method of analysing experimental results concerned with the behaviour of elasto-viscous bodies. It is shown that the transient equation for relaxation processes can be deduced from the experimental impedance formula, and that relaxation experiments are in agreement with the deduced transient equation. A differential equation relating stress, strain and time is derived from the experimental impedance formula. The relation of this equation to the well-known Maxwell equation is discussed. AUTHOR.

4563. Viscosity of Sodium Amalgams. H. E. Bent and N. B. Keevil. *J. Phys. Chem.* 40. *pp.* 709–714, *June,* 1936.—The viscosity of liquid sodium and silver amalgams is found to be independent of time. No scum forms on sodium amalgams when kept in glass containers which have been properly baked and evacuated. These experiments lessen the probability that sodium amalgams are colloidal. AUTHORS.

4564. Coefficient of Viscosity of a Liquid by Torsional Vibration Method. T. Okaya. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 268–279, *June,* 1936. *In English.*—A hollow cylinder is filled with a liquid and subjected to torsional free oscillations. The period, logarithmic decrement, and moment of inertia are measured and from these, by considering the various parts of the liquid and the forces acting on them, an expression is obtained for the viscosity of the liquid. Comparisons of results for water containing various percentages of alcohol agree very closely with those given in Fowle's Smithsonian Physical Tables. The full theory of the method of calculating the viscosity is given. H. M. B.

4565. Viscosity Nomographs for Alkaline Solutions. D. S. Davis. *Indust. & Engin. Chem.* 28. *pp.* 953–956, *Aug.,* 1936.—This paper is a review and development of the work of Hitchcock and McIlhenny on viscosities of aqueous solutions of NaOH, Na_2CO_3, KOH, and K_2CO_3, and of their mixtures. J. K.

4566. Viscosity of Dilute Solutions: Methods and Measurements in Solutions of Hydrocarbons. K. H. Meyer and A. van der Wyk. *Kolloid Zeits.* 76. *pp.* 278–289, *Sept.,* 1936.—The experimental determination of the specific viscosities of dilute solutions is described, whereby it is established that the customary methods lead to large errors if the viscosity measurements are not conducted with the greatest accuracy. Consequently, the authors discuss thoroughly the quantitative accuracy of the methods examined and the nature and limits of the errors involved. The results of the measurements with different hydrocarbons show that the specific viscosity should not be described as a function of the length of the dissolved molecule alone, butas dependent on the whole constitution and that in a complicated manner. The dependence of the specific viscosity on the temperature and concentration indicated that the dissolved particles, even in very dilute solutions, do not behave as rigid rods in suspension. H. H. Ho.

4567. Chemical Structure of Lubricating Oils. L. A. Mikeska. *Indust. and Engin. Chem.* 28. *pp.* 970–983, *Aug.,* 1936.—This report presents a study of the structure of lubricating oils on the basis of synthetical rather than analytical work. Several series of hydrocarbons consisting of alkyl derivatives of benzene, naphthalene, and diphenyl have been prepared to determine the effect of chemical structure on their chemical and physical properties. A relationship is established for these hydrocarbons between their viscosity characteristics and chemical structure. This study includes such structural factors as length, unsaturation, and branching of side chains. The effects of viscosity of other characteristics such as cyclisation, reduction of aromatic to hydroaromatic rings, multiplicity of side chains, and allocation of the latter in the nucleus, are also considered. AUTHOR.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4568. Construction of Cellular Mirrors for Astronomical Instruments. N. G. Ponomarev.** *Zeits. f. Instrumentenk.* **56.** *pp.* **379–384,** *Sept.,* **1936.**—The paper reports a series of experiments in the preparation of rigid but light mirrors by fusing together a thin surface sheet and a backing of honeycomb cells [see Abstract 3786 (1935)]. The use of metal cells proved quite impracticable, and Pyrex was found to undergo devitrification during the process. In further experiments the use of hollow spheres was also abandoned. The most successful trial has been with a special glass of low expansion, and cells shaped in advance into approximately their final form. The most advantageous temperature curve of the oven appears to be as follows : steady warming until the glass begins to soften, then rapid heating and equally rapid cooling to the point where fine annealing commences ; the latter is, of course, then to be carried out very slowly. An outstanding difficulty, that the cell walls tend to thicken at the lower side, is discussed. The polishing and Foucault testing of a 12-in. spherical mirror is described ; the separating power is near the theoretical value and the mirror is to be parabolised and tested for astronomical use. T. L. M.

See also Abstracts 4573, 4577.

COMETS AND METEORS.

4569. Probability of Discovery of Comets and Distribution of Cometary Orbits. P. Bourgeois and J. F. Cox. *Bull. Astronomique,* **9.** 7–9. *pp.* **349–446, 1934.**—Comets which satisfy certain conditions as to distance from sun and earth are defined as " visible " comets. Only a fraction of these can be discovered by the various methods in use at various periods. The authors set up an expression for the probability of discovery in terms of the lengths of time during which the comet exceeds certain magnitudes. Approximate conditions of certainty are derived from comet catalogues. Typical parabolic paths, reduced to trajectories in the comet-earth-sun plane, are plotted on an isophot diagram in stellar magnitudes around earth and sun. The isophots are fully tabulated for laws $1/r^2\Delta^2$ and $1/r^4\Delta^2$ and are applicable to other reductions, *e.g.*, minor planets. The paths selected are for six perihelion distances from 0·2 to 3·0 and cover 30° values of i and ω. The probabilities of discovery in each case are also fully tabulated. The results are compared with the observed distribution of the various elements of the orbit. The distribution of the absolute magnitudes of comets is fully discussed and compared with the observational results of Vsessviatsky ; the fraction discovered falls off very rapidly ; the results suggest no boundary between comets and interstellar matter. It is then possible to rediscuss the observed connection between the position of perihelion and the seasonal epoch of perihelion passage and to apply a correction to the observed distribution of perihelia [see Abstract 2781 (1934)]. When this is done, the distribution derived by Oppenheim shows a preference for the direction normal to that of the centre of the galaxy, already indicated by the authors. The preference for the N. hemisphere and the influence of conditions of observation require further discussion. T. L. M.

COSMOGONY.

See Abstract 4571.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4570. Theorems in Dynamics of a Steady Stellar System. S. W. Shiveshwarkar. *Roy. Astron. Soc., M.N.* 96. *pp.* 749–758, *June,* 1936. —Eddington's theorem on principal velocity-surfaces is extended from the exponential distribution function to the general ellipsoidal type. Eddington's discussion of globular stellar systems is extended by means of Jeans' theorem to the general ellipsoidal distribution and it is shown that Eddington's results follow as a special case. Corresponding formulæ for a rotating galaxy are derived. T. L. M.

4571. Stellar Kinematics and the K-Effect. S. W. Shiveshwarkar. *Roy. Astron. Soc., M.N.* 96. *pp.* 758–760, *June,* 1936.—In Milne's paper [see Abstract 3344 (1935)] it is shown that stellar motions involve a double wave in longitude in any plane whatever the mode of systematic motion. The author shows that this does not contradict the hypothesis of galactic rotation, but only proves the more general theorem that for an analysis of the type of systematic motion the direction of the centre of the system must first be known from sources other than stellar motions (*i.e.*, such a method as Shapley's, from distribution of globular clusters). T. L. M.

LATITUDE AND LONGITUDE.

4572. International Observations of Longitude, 1933. A. Lambert. *Bull géodésique, No.* 48. *pp.* 423–431, *Oct.–Nov.–Dec.*, 1935.— Results have been received at the *Bureau internationale de l'Heure* from 62 observatories and stations of (1) observations of signals in local pendulum time corrected for parallax of the pen according to a previously suggested scheme, (2) abstract of astronomical observations to permit a new method of reduction, and (3) the value of the pendulum correction adopted by the observer in true sidereal time. An outline is given of a method for control correction to these results which has been applied according to the type of pendulum observations made. R. S. R.

4573. Laplace-Azimuth on High Latitudes. J. Schive. *Bull. géodésique, No.* 48. *pp.* 432–434, *Oct.–Nov.–Dec.*, 1935. *In English.*—The author has stated that difficulties in determining the Laplace-azimuth increase with latitude and much more work is required in high latitudes. Jelstrup however concludes [see Abstract 4502 (1935)] that the accuracy in the geodetic observations is independent of latitude but the same errors in triangulation give a greater azimuth-error in high latitudes than in low. The author shows that with errorless astronomical observations the residual is completely independent of latitude and that part of the azimuth-error, which corresponds to the error in longitude, is eliminated. In reality it is for the convergence of the meridians that Jelstrup's considerations apply. R. S. R.

See also Abstracts 4514, 4533, 4558.

NEBULÆ.

4574. Reflection Nebulæ. O. Struve, C. T. Elvey, and F. E. Roach. *Astrophys. J.* 84. *pp.* 219–228, *Sept.*, 1936.—In order to test the reflection theory of galactic nebulæ having continuous spectra, observations were made, with a Schmidt camera, of the nebulosities in the dark

cloud in Scorpius and Ophiuchus. A large red nebula was found, extending about one degree to the north from Antares and only a few minutes of arc to the south. The colour index of this nebula is about + 1·5 mag., which agrees satisfactorily with the colour index of Antares. The average colour index of the nebulæ surrounding the B stars σ Sco, 22 Sco, − 24°12689, ν Sco, and ρ Oph is − 0·1 mag., which is also in good accord with the colour indices of these stars. The colour index of the night sky was found to be about + 0·5 mag. The colour index of a nebula near γ Cyg is 0·0 mag., which is much bluer than this F8 star. Perhaps this is a case of Rayleigh scattering. There can be no appreciable Rayleigh scattering in the nebulæ in the Scorpius-Ophiuchus region. A small amount of radial polarisation was found in the nebula surrounding ρ Oph.
AUTHORS.

See also Abstracts 4520, 4521.

PLANETS.

4575. Grazing Planetary Transits. M. de Saussure. *Arch. des Sciences*, 18. *pp.* 179–192, *July–Aug.*, 1936.—Transits of Mercury occur 12 to 14 times in a century, but grazing transits only about once in two centuries; and on May 11, 1937, only part of Mercury will be seen on the sun's disc in certain parts of the world. It will be invisible in Europe, except possibly on the chromosphere, using a spectroscope as one does for prominences. The data have been calculated precisely and simply by a modification of Lagrange's method for ordinary transits. A map and a diagram show the conditions and times of visibility all over the world. The northern limit crosses central Africa and southern Asia, including India and China. M. A. E.

4576. Visual Observation of Jupiter. B. M. Peek. *Observatory*, 59. *pp.* 272–282, *Sept.*, 1936.—Recent visual work on the currents and drifts in the atmosphere of Jupiter is discussed. Latitudes are obtained by the filar micrometer; longitudes by eye estimations of meridian transit; the precision obtainable by the latter method is shown to be ample at present except for irregularities in the motion of individual spots. Recent progress has been due to cooperative work, especially in Britain. Observers in the S. hemisphere are urgently required; many phenomena are missed when Jupiter is in S. declination. As Jupiter rotates in 10 hr., observers in Europe cannot generally observe successive transits; international cooperation is recommended. Photographs should be taken in future in conjunction with eye observations. Three recent phenomena are discussed; the ejection of a series of spots in the S. equatorial belt in 1928; an outburst of rapid spots in the N. temperate belt in 1929; and a recurrence of circulating spots about the S. tropical disturbance in 1932.
T. L. M.

STARS.

***4577. Photographic Stellar Photometry. M. de Saussure.** *Bull. Astronomique*, 9. 6. *pp.* 311–347, 1934.—Different methods used for determining photographic magnitudes are reviewed, some of which need two separate exposures for each star, and some suffer from loss of light. A new method is explained in detail, which is an adaptation, with modifications, of that for determining colour indices. Its advantages are: (1) simultaneous single exposure for the two star images to be compared; (2) applicability to measurement either of diameters or intensities of images;

(3) absence of prism or any optical device in front of the objective; and (4) satisfactory accuracy of the results obtained. M. A. E.

4578. Photographic Stellar Photometry. A. Lallemand. *Bull. Astronomique*, 9. 7–9. *pp.* 447–454, 1934.—The author investigates the properties of photographic images taken at the focus; within the whole circle which defines the image the illumination impressed on the plate is high enough for saturation and he spreads the luminous flux over an area practically equal to the normal dimensions of focal images and measures the entire density of the small portions thus formed. He describes the methods of Fabry, Schilt, and Liau where the plate is at a short distance from the focus, and gives his own improvements on theirs. He uses artificial points of light for a magnitude scale and gets them by placing a screen pierced by a hole of 0·3 mm. dia. before an acetylene jet flame under constant pressure. By means of small achromatic lenses of 7 cm. focus, placed side by side 2 m. from the hole, the beams traverse a neutral glass whose thickness is computed so as to form a convenient scale, but the glass is not actually in contact with the plate. The microphotometer gives measures of density, nearly to 0·001, and the precision obtained is limited only by dust, defects in the emulsion, and the intrinsic properties of the photographic plate. A. S. D. M.

4579. Scorpio-Centaurus Star Stream. C. Bertaud. *Comptes Rendus*, 202. *pp.* 2047–2049, *June* 22, 1936.—An analysis of Draper Catalogue stars below and including 8·0 magnitude in the region 8–20 h., −10° to —80°, for which proper motions are known, reveals the presence of a group of stars of small absolute velocity, between 9 h. and 17 h., type B0–B8. As a check, A stars do not show the effect. By the Charlier method, the author finds a velocity of 18·4 km. in direction R.A. 6 h. 27 m., dec. −40°. B stars with emission lines average about 0·3 magnitude brighter than normal B stars. T. L. M.

4580. Rapid Colour Variations in Stars. M. Maggini. *Accad. Lincei, Atti*, 23. *pp.* 336–339, *March* 1, 1936.—Taking up again the problem suggested [see Abstract 529 (1934)], a double photometer has been made, with two photoelectric cells, one of Na the other of Rb, and any variation in the difference of magnitude as measured by the different cells is equivalent to a variation in colour of the star observed. Such changes in colour, occurring within a few minutes, have been recorded in some variable stars, especially AR. Cass., of Algol type, and β Lyræ. Slight variations have also been observed in stars not variable in magnitude. M. A. E.

4581. Apparent Diameter and Effective Wave-Length of Stars. P. Rossier. *Arch. des Sciences*, 18. *Suppt. No.* 2. *pp.* 82–83, *April–July*, 1936.—The author has given formulæ for calculating the apparent diameter of a star from its visual magnitude and effective temperature. Recent interferometer measures of γ Aqu., ε Peg., and Antares are compared with the computed values, with which they agree to about 5%. The author's formula for effective wave-length is also verified from the observational data. [See Abstract 2988 (1935) and following Abstract.] T. L. M.

4582. Photographic Effective Wave-Length. P. Rossier. *Arch. des Sciences*, 18. *Suppt. No.* 2. *pp.* 83–85, *April–July*, 1936.—The work of Lobsien at Hamburg, using grating spectra, gives systematic differences in the effective wave-lengths according as visual and microphotometric methods are used. It is shown that the difference is due to the optical centre of the spectrum not coinciding with the maximum of intensity; the difference is then given as accurately as can be expected by the author's theory [see preceding Abstract], which also gives the constants of sensitivity of the plates in good agreement with other determinations. T. L. M.

4583. Width of Stellar Hydrogen Lines. P. Rossler. *Arch. des Sciences*, 18. *Suppt. No.* 2. *pp.* 85–86, *April–July*, 1936.—The relative width of stellar H lines has been shown to be sensibly constant over types A, F. The author extends this to type B5, using 65 spectrograms, and therefore to temperature range 7000° to 14,000°, approximately. T. L. M.

4584. Spectrum of 25 Orionis. Helen W. Dodson. *Astrophys. J.* 84. *pp.* 180–202, *Sept.*, 1936.—During the years 1915–1933, simultaneous variations of velocity occurred in the central absorptions and the emission lines of H, and nearly synchronous changes of the ratio V/R of the components of the emission lines. The period decreased from 1817 to 1025 days, and the velocity amplitude of the central absorptions varied. The central absorption velocities of Hβ,Hγ, Hδ, are in phase; but the emission velocities anticipate them by about 100 days. The emission ratio V/R differs in phase from line to line; and the lines vary in width, maxima occurring at times of maximum and minimum velocity. The He lines and the H absorption underlying the emission show variations in velocity and contour, related to the velocities of the H central absorption but out of phase with them. Except for this, the observations can be satisfactorily interpreted by the rotating and pulsating theory of McLaughlin. M. A. E.

4585. Galactic Rotation of Globular Clusters. H. Mineur. *Comptes Rendus*, 202. *pp.* 2132–2134, *June* 29, 1936.—The author applies his previous method [see Abstract 522 (1936)] with some modifications, to the radial velocities of globular clusters published by Edmondson. The results confirm the conclusion that these clusters participate in a retrograde galactic rotation, which is a maximum at about 15,000 parsecs from the galactic centre, decreasing to zero at about 25,000 parsecs; these values are for the galactic plane; the velocity decreases normally to this plane and reaches zero around 10,000 parsecs from it. The velocity is about 330 km./sec. at the distance of the sun from the centre of the galaxy. T. L. M.

4586. Expansion-Luminosity Relation for Novæ. F. Zwicky. *Nat. Acad. Sci., Proc.* 22. *pp.* 457–462, *July*, 1936.—The purpose is to correlate certain of the observable features of Novæ: maximum absolute magnitude, $M_{\max}$; total visual energy, E_{vis}; velocity of expansion of ejected gases, v; life-time of the Nova, τ. The author's model is therefore only briefly outlined: the relations obtained are fully compared with the available observational data for seven stars. The derived expansion-luminosity relation is $M_{\max} = -5 \log v + 32\cdot35$; the expansion-visual energy relation: $\log E_{\text{vis}} = 3 \log v + 20\cdot04$; and a possible luminosity—life-time relation $M_{\max} = -5 \log \tau + \text{const.}$ Several aspects in which the theory can be improved are considered, notably by the use of the total range in magnitude. T. L. M.

4587. Nova Lacertæ 1936. D. Belorizky. *Comptes Rendus*, 203. *pp.* 397–398, *Aug.* 10, 1936.—Fifty Marseilles spectrograms show that the Nova radiated at discovery (June 19) like a black body; the spectrum changed the following day and in July showed very wide emission bands of H and N. The continuous spectrum became weak but still visible. On

July 14 with short exposure only the Hα band was visible; the radiation was apparently almost monochromatic. T. L. M.

See also Abstracts 4570, 4571, 4704.

SUN.

4588. Total Solar Eclipse of June 19, 1936. Observations at Omsk. J. A. Carroll. *Nature*, 138. *pp.* 349–352, *Aug.* 29, 1936.—Three observing instruments were used: (1) A very rapid objective prism spectrograph for infra-red corona with range from sodium D-lines to about 11,000 Å on Ilford S.R. Panchromatic and Agfa 800 Contrasty and Agfa 950 plates, to get coronal radiation about 9600 Å (probably unsuccessful) and the line 7896 Å (successful); (2) an objective interferometer of 13 cm. aperture and 105 cm. focal length, used with a Fabry-Perot étalon which should give at all points of the corona such information as the variation in wave-length, strength, profile, width of line selected, rotation and internal motion of the coronal material (an accident in the total phase allowed the comparison fringes only to be seen); (3) an echelon spectrograph with automatic camera giving successive 1·5 sec. exposures on the flash. The Aberdeen transmission echelon of 33 plates, each 1 cm. thick, and height of step 1·1 mm., width 37 mm. was used. The spectra proved too faint for the flash but the spectrum of darkening towards the limb which was disappearing in the last minute of arc was well shown over the region 4,000–5,000 Å. The author describes the temperature control of the apparatus. A. S. D. M.

4589. Ultra-Violet Content of Sunlight at Bombay. N. R. Tawde, S. A. Trivedi and J. M. Patel. *Indian Journ. Phys.* 10. *pp.* 277–279, *July*, 1936.—By using the methods of photographic photometry, the effective energy distribution of solar radiations at Bombay has been measured and the percentage u.v. content of it has been calculated. It is thus found that only about 2·43 % is u.v. light in solar radiations. AUTHORS.

4590. Equation of Rotation of Photospheric Layers. R. Emden. *Zeits. f. Astrophysik*, 12. 4. *pp.* 233–246, 1936.—Observations of the rotation of the photosphere have generally been represented by a formula of Faye; Giao's more recent formula has been used by Dedebant and others; it is shown that it does not represent the data better and that the accuracy of the observations is insufficient to distinguish. Seven formulæ are derived on various assumptions, some differing widely, and shown to represent observation with sufficient and almost equal accuracy. Some of the physical considerations brought forward by Dedebant and others [see Abstract 587 (1935)] are discussed, including the treatment of viscosity and the Navier-Stokes expression, and the application of the principle of least dissipation. T. L. M.

See also Abstract 4907.

ZODIACAL LIGHT AND GEGENSCHEIN.

See Abstract 4624.

GEOPHYSICS.

GEODESY.

4591. Figure of the Geoid and Gravity Measurements. B. Numerow and D. Chramow. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 193–208, 1936. *English Abstract.*—The application of the usual linear relations between the coefficients of the spherical function development of the radius-vector of the geoid and the gravity involving errors of the order of the square of flattening is emphasised. Formulæ (56) and (57) of the original give developments of the radius-vector of the geoid and the gravity to spherical functions of the fourth order, and to quantities of the order of the square of flattening, inclusive. Some methods of deriving the figure of the geoid are suggested. AUTHORS.

See also Abstracts **4573, 4574.**

HYDROSPHERE, PHYSICS OF THE.

4592. Atmospheric and Ocean Currents. Sjan-zsi Li. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 183–187, 1936.—A comparison is here made between ocean currents and air currents in the lower atmosphere. It is established that the horizontal, vertical and return currents in the two elements show a definite resemblance. The causes of the ocean currents are discussed. Reasons for the divergence in direction in the horizontal air and sea currents are given. The analogies between the two systems are summed up and set out in tabular form. A. E. M. G.

4593. Effect of a Local Wind upon the Sea Surface and on the Internal Boundary Wave. T. Takegami. *Kyoto Coll. Sci., Mem.* 19. *pp.* 109–130, *May,* 1936. *In English.*—In the present paper, from a simple theoretical calculation, an investigation is made of the elevation or depression of the sea surface and the variation of the total flow of the current generated by a travelling local gale of large scale (such as a cyclone), and, secondly, of the generation of the internal long wave of great height. AUTHOR.

4594. Waves Caused by Sudden Deformation of Sea Bottom. S. Syôno. *Geophys. Mag., Tokyo,* 10. *pp.* 21–41, *Aug.,* 1936. *In English.*—The case is considered where the area deformed (by elevation or depression) extends over a finite area, the depth of the sea being uniform and either very large or very small compared with the area of the deformed portion. C. A. S.

4595. Effect of Prevailing Winds upon the Depth of Bays. M. Nakano. *Geophys. Mag., Tokyo,* 10. *pp.* 71–88, *Aug.,* 1936. *In English.*—Theoretical considerations based on Ekman's theory of drift current were made in the direction of the general current produced by prevailing winds especially near the sea bed for the transport of sand particles taking the cases of an enclosed sea and a straight coast. The results were applied to a bay, peninsula and island and found to be correct in substance. The bay is really intermediate between the other two cases considered. It was found that the effect of the deflecting force due to the earth's rotation upon the direction of the general current was negligibly small if the depth of sea or bay was shallower than half the depth of frictional influence. [See Abstract 4522 (1935).] R. S. R.

4596. Rainfall and Stream Flow. Part II. R. T. Zoch. *Monthly Weather Rev.* 64. *pp.* 105–121, *April*, 1936.—This is a continuation of previous work [see Abstract 1529 (1935)]. Instead of considering an ideal drainage area of rectangular shape the author deals with drainage areas such as are found on the earth's surface. The paper is divided into two parts. In Part I the problem and the method of approaching it is outlined. Part II treats the problem mathematically. In Section I expressions are derived which give the total discharge and the time of maximum discharge (t_e) from a drainage area when overland travel is taken into account. From these it is shown that while there is a systematic error in t_e when overland travel is neglected, the error in y_e, the discharge, is negligible. The problem of the discharge and rate of discharge from triangular and elliptical drainage areas is treated in subsequent sections. These areas present considerably greater difficulties than the rectangular. General equations giving the discharge, etc., for a drainage area of any shape are then established and the form of the drainage area curves which should be fitted in the practical application of the theory, discussed. The paper concludes with a references to additional discharge equations. Tables and line diagrams illustrate the paper. A. E. M. G.

4597. Seiches in an Infinite Canal. K. Hidaka. *Geophys. Mag., Tokyo,* 10. *pp.* 67–70, *Aug.*, 1936. *In English.*—In an infinite canal, whose breadth and depth are uniform, gravitational oscillations of any period can take place. In a canal with an undulatory bed only a sequence of periods can occur when the bed of the canal presents infinite trains of undulations. W. A. R.

See also Abstract 4800.

LAND, PHYSICS OF THE.

4598. Electrical Conductivity of Rocks. (Mrs.) F. Bayard-Duclaux. *Ann. de Physique,* 6. *pp.* 5–107, *July–Aug.*, 1936.—The literature on the subject and the experimental methods are discussed. It is found that the resistivity increases with the passage of the current, but tends towards a limit, and the values given are those which approximate sufficiently closely to this. Conductivity also varies with the potential. Between 15° and 52° C. the conductivity varies according to a definite logarithmic law. The resistance of rocks, completely dried, is always greater than 6×10^{11} ohms. The conductivity of a humid specimen is probably neither entirely electrolytic, nor entirely a surface phenomenon. It makes little difference whether rocks are saturated in water or in saline solution. Studies were also made of the conductivity in copper sulphate, and it was found that copper penetrated into the specimen. W. A. R.

4599. Elastic Properties of Rocks. J. M. Ide. *Nat. Acad. Sci., Proc.* 22. *pp.* 482–496, *Aug.*, 1936.—The modulus of elasticity (μ_D) and Poisson's ratio (σ_D) have been determined by dynamic methods for several of the rock samples for which Zisman had determined them statically (μ_s and σ_s) [see Abstract 4419 (1933)]; μ_D is deduced from the torsional resonance frequencies of large cores, σ_D by Glebe and Blechschmidt's method [see Abstract 52 (1934)]. From these results and Young's modulus previously determined both statically and dynamically (E_s and E_D) [see Abstract 2092 (1936)], the cubic compressibility (β) and the velocities of longitudinal (V) and transverse (v) waves in the rocks [see

Abstract 4818 (1933)] σ was calculated in five different ways. Comparison of all these results, showing discrepancies far in excess of experimental errors, is made and shows how far these rocks differ from an ideal elastic medium. Agreement is excellent for metals such as steel and copper or a fine-grained igneous rock such as diabase, but discrepancies are increasingly large in the order norite, quartzitic sandstone, dolomite, marble, granite and gneiss. C. A. S.

See also Abstract **4773**.

METEOROLOGY.

4600. Huggins' Bands in the Spectrum of the Sky and the Temperature of Atmospheric Ozone. J. Dufay. *Comptes Rendus*, 203. *pp*. 383–386, *Aug*. 3, 1936.—The absorption bands in the region 3189—3303 Å in the spectrum of the light from the sky at the zenith with the sun near the horizon have been observed. The ratio of the intensities of the same radiation at two different instants can be represented by $\log I_1/I_2 = A + K_\lambda (e_2 - e_1)$, where K_λ is the coefficient of absorption, $(e_2 - e_1)$ the difference in thickness of ozone. The method of determining K_λ is indicated. By a diagram it is shown how the coefficients K_λ arrange themselves along the absorption curve determined in the laboratory at ordinary temperature. The value of ΔK, the difference between the absorption coefficients at a maximum and a neighbouring minimum in eight different sections in the region examined obtained from four different sources are arranged in tabular form and compared. From this it appears that atmospheric ozone behaves as though its temperature was definitely below 15° C. but much above — 80° C. A. E. M. G.

4601. Distribution of Ozone in the Atmosphere. O. R. Wulf and L. S. Deming. *Terr. Mag*. 41. *pp*. 299–310, *Sept*., 1936.—A calculation is made of the distribution of O_3 with height on the assumption of an undisturbed photochemical steady state under the influence of solar radiation. The number of O_3 molecules is expressed as a function of the height. All quantities occurring in the expression are known approximately except a numerical constant which is determined from the known total amount of atmospheric O_3. The distribution of O_3 so found resembles rather closely that which has been determined by observation. The characteristics of this distribution depend on the atmospheric constituents and the nature of the O_2–O_3 absorption-coefficient curve. The importance of the values of the absorption-coefficient of O_2 and O_3 in the region where the two absorptions meet is illustrated. The present work assumes that the sun is in the zenith and radiates as a black body at 6000° Abs. A. E. M. G.

4602. Charge and Attachment of RaA in Atmospheric Air Enriched by Radon. G. Aliverti. *Gerlands Beitr. z. Geophys*. 48. 2–3. *pp*. 121–130, 1936. *In Italian*.—Experiments are described to make clear the conditions in which RaA is deposited due to its positive charge. Using the flow method in filtered air and a negatively charged collecting plate, nearly all the RaA is deposited; this is in contrast to the Gerdien method, where about 1/5 of the total is deposited. With a positive electrode a small percentage of RaA + RaB + RaC is collected. In unfiltered air, the collection of RaA + RaB + RaC occurs for both methods and with positive or negative collecting electrodes. The fraction of N shown is higher for the former electrode. [See Abstract 3556 (1936).] H. M. B.

4603. Cooling in the Lower Atmosphere and the Structure of Polar Continental Air. H. Wexler. *Monthly Weather Rev.* 64. *pp.* 122–136, *April*, 1936.—From considerations of radiative balance between the air and the snow surface the author is able to show that the surface temperature cannot fall below a certain value without a simultaneous decrease of the maximum air temperature. As introduction to the problem the characteristics of polar air masses, maritime and continental, are discussed by considering the results of actual soundings. These show considerable differences in the height of the tropopause. Heat is lost to space by way of the snow surface. A full examination of this process is made. But the atmosphere loses heat also directly to space. This loss occurs from the upper levels of the troposphere and has an important effect on the lapse rate in upper levels. With emission from both, the lower atmosphere contracts but this in itself does not account for the difference in height of the tropopause, and the author considers that other factors enter. He then examines mathematically the rate of decrease of surface and free air temperatures over the continent. Thereafter from an examination of the height and temperature of the tropopause over polar maritime and polar continental air it is concluded that a continental tropopause should be lower and warmer than a maritime. The paper concludes with a short discussion of the effects of subsidence. A. E. M. G.

4604. Eight-Year Temperature Variation. F. Hummel. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 268–302, 1936.—Harmonic analysis of the numbers of frosty days in March at Karlsruhe during the past 50 years, checked by Berlin records over some 140 years, indicates an 8-year period of variation of temperature, the amplitude of which appears further to vary with a period of 68–70 years, and to be connected with the number of sunspots. The origin of the oscillations, at which the amplitude is about 3°, is located between 60° and 70° N°, whence they radiate in all directions. C. A. S.

4605. Gradient Winds. K. Hidaka. *Geophys. Mag.*, *Tokyo*, 10. *pp.* 13–19, *Aug.*, 1936. *In English.*—The author adopts the equations of Taylor's vorticity transport theory and assumes a particular expression for the coefficient of eddy viscosity. From the solution it is found that the effect of the ground vanishes at a finite height. This is termed the gradient wind height and increases with the velocity of the gradient wind. The author hopes to test this result experimentally. A. E. M. G.

4606. Theory of Convection Thundershowers, Convection Cyclones and Anticyclones. H. Arakawa. *Geophys. Mag.*, *Tokyo*, 10. *pp.* 43–66, *Aug.*, 1936. *In English.*—The fundamental principles of convection and the hydrodynamical theory of air motion on a rotating globe are used as a basis in the present paper, and from them deductions drawn regarding the varied characteristics which secondary circulations, so produced, have. The equations of motion are first stated and investigated assuming various boundary conditions. Application of the solutions of these equations is made in the next section which deals with convection cyclones and anticyclones. The author considers that his results support a modified Ferrel's view of the mechanism of a cyclone. The height of tropical cyclones has often been regarded as comparatively small. From observations on high clouds made in latitude $\theta < 31°$ N., it is found, however, that air currents flowing in a cyclonic sense, are observable. Hence it appears that tropical cyclones are about the same height as those of middle latitudes. An investigation of the effect of shear and rotation of the earth on the stability of air masses concludes the paper, a table being compiled showing the critical values of lapse-rate for stable stratification. A. E. M. G.

4607. Stationary High and Low Pressure Areas. K. Wegener. *Gerlands. Beitr. z. Geophys.* 48. 2–3. *pp.* 225–228, 1936.—The author first points out how these stationary high and low pressure areas arise through the effect of radiation taking as example the high pressure system over Asia. The differences between them and the moving pressure systems are referred to. These stationary systems are shown to correspond to Ferrel's high pressure model. The effect of radiation on the air from the Greenland Ice Cap is then discussed. The winter low pressure system over the Mediterranean (*Mittelmeer*) serves as an example of the Ferrel type of low pressure system. Attention is drawn to the necessity when forecasting of considering carefully how surfaces may affect air masses through radiation. A. E. M. G.

4608. Rainfall at Fronts of Depressions. A. H. R. Goldie. *Meteorolog. Office, Geophys. Mem. No.* 69, [18 *pp.*], 1936.—The period examined extends from Oct. 1929, to Sept. 1932. The stations considered are of three types (1) western island, (2) western mainland, (3) eastern mainland stations on the British Isles. Certain diurnal variations are found in the amounts of warm-front and cold-front rainfall, and these are discussed in detail. An examination of the mean amounts and rates of rainfall in different places, seasons and meteorological conditions shows that very considerable changes occur in the precipitation of depressions as they pass across the British Isles. Thus any statement as to average amounts of rain at different places must be made with qualifications. Still the author has been able to formulate some general rules as a guide to the behaviour at west and east coast places as compared with the outer islands. A comparison of the results is made with those obtained under continental conditions in Central Europe. The paper is illustrated by a number of line diagrams. A. E. M. G.

4609. Diffusion and Absorption in the Whole Atmosphere. A. Gordov. *Gerlands. Beitr. z. Geophys.* 48. 2–3. *pp.* 131–150, 1936.—Earlier theoretical work relating to scattering and absorption in the atmosphere often dealt with an ideal atmosphere composed solely of gas molecules and ignored local or temporary changes of gas molecules, water vapour and dust. The author deals with an atmosphere containing molecules and also suspended material particles in producing diffusion and absorption. In the expressions obtained the effects of repeated diffusion and reflection from the earth's surface for each albedo are considered. He uses and resolves the suitable equations given by Mecke for the flux in high and low levels of the terrestrial atmosphere and these lead to results concerning the heat balance of the atmosphere. R. S. R.

4610. Polarisation of Light from the Sky at the Pole and other Observations. W. Smosarski. *Gerlands. Beitr. z. Geophys.* 48. 2–3. *pp.* 213–224, 1936.—The angle between the plane of polarisation of the diffused light from the sky at the pole and the horizontal plane of the sun has a diurnal variation which reverses between winter and summer and is thus connected with points of Babinet and Arayo. At and after sunset at all seasons the plane of polarisation at the pole turns in the opposite direction to the apparent solar movement. At the equinoxes the daily range of the degree of polarisation at 90° distance from the sun in the vertical plane is as large as at the pole and is thus independent of the variation of angular height of the observed light ray. The degree of polarisation at the pole is often less than at the corresponding point of the sun's vertical circle at the same distance from the sun when the sun is high, but when the sun is below 20° it is greater. Observed values of the degree of polarisation in the sun's vertical plane at distances from the sun of 60°, 90° and 120° are tabulated and the upper mean limits of the position of the maximum polarisation are calculated. The limit is 90° 17′ distant from the sun for a height of 60° of the sun and increases regularly to 92° 16′ as the sun's height decreases to zero. R. S. R.

***4611. Measurement of Temperature on Board Ship. N. Russeltvedt.** *Geofysiske Publ.* 11. 10. *pp.* 3–8, 1936. *In English.*—The difficulties in using older methods and the errors in these methods are first discussed. A type of aspiration thermometer for measurement of air temperature is described. It has a valve to control the air flow which runs freely when exposed in the wind but the rate is reduced to 1/20th when the reading is obtained immediately afterwards under cover. The lag constant of the instrument is found and errors do not exceed 0·1° C. for air temperature. For sea temperature a mercury in stainless steel thermometer is described for use in the inflow for the condensers. R. S. R.

***4612. Precipitation Collector. L. W. Pollak and F. Fuchs.** *Gerlands. Beitr. z. Geophys.* 48. 2–3. *pp.* 209–212, 1936.—A new model of the totalisator which was designed by Pollak, [see *Meteorolog. Zeits. p.* 360, 1932] is described. The original spiral glass tube passing round the collecting vessel is replaced by a number of straight, slightly inclined glass tubes. These communicate with the inside of the precipitation vessel and with each other. The method of collecting and measuring precipitation is described. Illustrations of the instrument are reproduced. A. E. M. G.

***4613. Simple Actinometer. A. Ångström.** *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 303–306, 1936. *In English.*—A simple thermometer with a spiral bulb is exposed to radiation, and the value of the radiation is given by the rate at which the temperature of the thermometer rises. Two conditions must be fulfilled: (1) the position of the thermometer in relation to the radiation must be sharply defined and (2) the initial temperature of the thermometer must be equal to that of the surroundings. The constant of this heliothermometer is found by comparison with Michelson's actinometer No. 535, and its value deviates by less than 2 % from the mean at whatever time of day it is used. H. M. B.

***4614. Hygrostat. H. W. Harkness.** *Journ. Sci. Instruments,* 13. *pp.* 288–290, *Sept.,* 1936.—A hygrostat has been constructed for use in the study of the hygroscopic nature of forest floor débris. It will maintain a constant relative humidity for any desired time and this can be instantly changed to a new value, which in its turn can be maintained. The construction and operation of the hygrostat are described, and the results of a typical test of its performance are reported. AUTHOR.

See also Abstracts 4462, 4527, 4592, 4596, 4616, 4617, 4624, 4773, 4794, 4904.

SEISMOLOGY.

4615. Two New Types of Seismic Waves. P. Caloi. *Accad. Lincei, Atti,* 23. *pp.* 507–511, *April* 5, 1936.—If the vector, representing a seismic vibration, consists of a component along the normal of the wave, this gives place to a longitudinal movement, and also of a component normal to the direction of propagation. This, in its turn, is decomposed into two: the one lying in the principal plane, and the other normal to the plane of propagation. W. A. R.

4616. Earthquakes and Atmospheric Pressure. F. B. Nopsca. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 229–238, 1936. *In English.*—When the earthquakes that occurred in Italy, Britain and Norway are classified according as they occurred after two days steady (by $\nless 0\cdot 9$ mm. per diem) increase or decrease in barometric pressure, by alternate increase and decrease, or by no change, and the resultant local distribution is plotted on the map, there seems to be some evidence that earthquakes in regions of erosion tend to be released by decrease in atmospheric pressure and vice versa, and that rise in pressure favours earthquakes where it may be supposed that the sial layer is thinning, *e.g.*, by continental drift, while similarly fall thereof has the same effect where a rise in sima may be presumed. [See following Abstract.] C. A. S.

4617. Earthquakes and Atmospheric Pressure. V. Conrad. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 239–253, 1936.—The methods of Nopsca [see preceding Abstract] are criticised on mathematical grounds, and it is shown that there is no satisfactory support for Nopsca's theory in the statistics therein given, while the deductions from Hungarian earthquakes now given are based on too few to be of real value. There is, however, some ground for supposing that variation in atmospheric pressure tends to release an earthquake if its effects are in the same direction as those of the earth movements in the region concerned. C. A. S.

4618. Deep-Focus Earthquakes in the International Summary. S. W. Visser. *Gerlands Beitr. z. Geophys.* 48. 2–3. *pp.* 254–267, 1936. *In English.*—The earthquakes of the deep-focus zone of the Pacific are carefully scrutinised and maps showing their distribution after revision throughout the circum-Pacific coasts given, as also of the Hindu Kush. These show the general applicability of Wadati's rule, and the close connection of such earthquakes with the deepest troughs of the Pacific, and similarly to some extent of the Atlantic. The facts are consistent with Holmes' theory [see Abstract 3432 (1933)] of sub-crustal counter-currents, but there is no explanation as to why these currents produce seismic activity near the margin of a continent or in the Hindu Kush, or why they are absent from N. America. C. A. S.

4619. Deep-Focus Earthquakes. C. Bois. *Comptes Rendus,* 203. *pp.* 101–103, *July* 6, *and pp.* 341–343, *July* 27, 1936.—The focal depths of 17 earthquakes (1) as calculated by Turner's method and given in the I.S.S.; (2) from phases reflected near the epicentre (pP, sS, pPP, etc.); (3) from Brunner's curves (for 3 only); (4) from the differences S − P (for 7 only); (5) from the phases PcP and ScS (for 12 only, at epicentral distances > 3000 km.) are compared with (6) the depths considered by Wadati [see Abstract 561 (1934)] as most probable. The results of all methods except (1) agree within about 10 %, but those from (1) average some 50 % greater. The geographical distribution of deep-focus earthquakes shows maxima on the eastern portion of the circum-Pacific geosynclinal (in the region of great depths near the Philippine and Marianne Islands) and in the region of Alpine folding between the Himalayas and Turkestan. Classification by depths and a consideration of whether the first wave was of compression or dilatation imply maxima at depths near those (100–120, 200–230, and 250–350 km.) where discontinuities have been suspected on other grounds. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

***4620. Point Discharge in the Electric Field of the Earth. F. J. W. Whipple and F. J. Scrase.** *Meteorolog. Office, Geophys. Mem. No.* 68. [20 *pp.*], 1936.—The apparatus used at Kew for recording point discharge in the atmosphere is described in detail and two typical records, illustrating the effects with continuous rain and with thunderstorms, are discussed. It is found that above a critical minimum value of the field the point discharge current is roughly proportional to the square of the potential gradient. It is shown that the outflow of + electricity from the point exceeds inflow in the ratio of 1·7 : 1 and the net outflow amounts to about 60 millicoulombs in a year. There is a well-marked diurnal variation in all seasons, the maximum discharge taking place in the afternoon. A statistical analysis of the sudden field changes caused by lightning flashes showed a preponderance of + over − changes in the ratio 3·5 : 1. There were a large number of cases in which the preliminary field just before a flash was very small (not much greater than the fine weather field). When the preliminary field was appreciable a reversal of the field was as frequent as a mere reduction. Speculations on the effect of a space-charge blanket on the vertical distribution of field below thunder clouds are put forward in explanation of the results obtained in this investigation. The importance of point discharge as a factor in the exchange of electricity between the atmosphere and the earth is discussed. R. S. R.

4621. Horizontal Electric Current Deduced from the Earth's Magnetic Force. K. Terada. *Geophys. Mag., Tokyo,* 10. *pp.* 111–130, *Aug.,* 1936. *In English.*—A formula $H = H_0\ (1 - 3\ h/R)$ is deduced as a first approximation for the horizontal electric current in the atmosphere. According to Schmidt's data it flows in a closed circuit. The current density is of the order 1 A/km². and from comparison with the ionic current it must be flowing in the ionosphere at a height of several hundred km. Magnetic force data of 1922 give similar results. It is found that (*a*) the current density is about 1 A/km². in most regions, but relatively great in high latitudes, (*b*) the meridional components of the current are extremely small compared with those on lines of equal latitude, and (*c*) the current flows eastwards north of 35° N. and between 5° S. and 55° S. but is reversed in other regions. The author imagines the sheet of the current is in the ionosphere and that it acts upon the earth's permanent field as a factor of the external magnetic potential. R. S. R.

4622. Effect of Wind upon the Earth's Electric Field at the Surface. J. G. Brown. *Terr. Mag.* 41. *pp.* 279–285, *Sept.,* 1936.—The effect of wind is studied by obtaining mean values for (1) 75 clear days with strong continuous N-W winds, (2) 50 days, mostly clear, with continuous S-E winds, and (3) 50 clear days with calm from midnight to sunrise. Local variations from the mean were computed for each series and shown in graphs. The possible seasonal effect to account for the differences in these three cases is considered to be small in comparison. The results are discussed and compared with those shown at Trieste, Washington, Stanford, Apia, Watheroo, and Manila. The extent and character of the inversion required to account for the daylight depression is considered and the effects of such other factors as nature of, and condensation on, nuclei, temperature, humidity and radioactive content of the air. R. S. R.

4623. Eccentric Dipole Approximating the Earth's Magnetic Field. J. Bartels. *Terr. Mag.* 41. *pp.* 225–250, *Sept.*, 1936.—A fairly good approximation of the earth's field would be produced by a magnetic dipole at the earth's geometric centre. Its axis would intersect the earth's surface in A (78°·5 S, 111°·2 E) and B (78°·5 N, 291°·2 W). The moment of the dipole would be $8\cdot 1 \times 10^{25}$ gauss. cm^3., and it would set up a maximum horizontal intensity of 0·315 gauss at the surface. If the observed field is to be approximated by that of a dipole not necessarily at the earth's centre, the best approximation is given by a dipole of the same strength as before, with axis parallel to AB, the dipole being 342 km. distant from the earth's centre in a direction towards a point 6°·5 N, 161°·8 E. The field of this dipole is computed, expressed in tables and charts, and discussed. The two approximations are then compared. The improvement in the approximation due to the shift of the dipole from the geometric to the magnetic centre is most distinct in the southern hemisphere. G. E. A.

4624. Auroral Spectrograms Taken at Chesterfield, Canada, during 1932-33. B. W. Currie and H. W. Edwards. *Terr. Mag.* 41. *pp.* 265–278, *Sept.*, 1936.—693 spectrograms of the auroral and night sky taken at 63° 20′ N., 90° 42′ W., some showing the effects of twilight and moonlight are studied. The radiations are identified and their frequency of occurrence is computed. The spectra suggest the light is auroral at all times and the green O line is not always present. The radiations at 6300 and 5940 Å increase during twilight and moonlight. The correlation between the spectra and the visual aurora, magnetic activity, and earth current activity is discussed. The correspondence between the intensity changes of 5577 Å, 3914 Å, the whole aurora spectrum, and the visual aurora is shown. The earth-current activity and magnetic activity show variations throughout the night similar to the hourly mean occurrence of 3578 Å. The spectrograms afford the only means of estimating auroral activity on cloudy nights. H. G. C.

***4625. A.C. Earth-Inductors. E. A. Johnson.** *Terr. Mag.* 41. *pp.* 251–260, *Sept.*, 1936.—The limiting sensitivity of earth-inductors is discussed from a theoretical and experimental point of view for the case of d.c. and a.c. methods of detecting the output. The effect of parasitic voltages is discussed and it is concluded that the a.c. detector may be made as much as 1000 times as sensitive as the d.c. detector. The particular advantage of a.c. methods of detection for marine observations is pointed out and it is shown that such observations can be made with greatly increased accuracy. AUTHOR.

***4626. Induction-Variometer for Magnetic Anomalies. A. G. McNish.** *Rev. Sci. Instruments,* 7. *pp.* 336–338, *Sept.*, 1936.—This instrument is specially designed to record continuously time-changes in the earth's vertical magnetic force. Its magnetic portions, made of perminvar with Ni : Co : Fe = 45 : 25 : 30 [see Abstract 609 (1929)], consist of four pieces each 52 × 5 × 2 mm. fixed vertically, two above and two below a gap in which two pieces of the same 7 × 2 × 1 mm. fixed symmetrically in a brass frame with mirror attached, are suspended by a quartz fibre. Calibration is effected by producing a known change in field with a Helmholtz coil. [See Abstract 3582 (1936)]. Modifications for use as a field instrument are suggested. C. A. S.

4627. Electrical Messages from the Earth: Reception and Interpretation. O. H. Gish. *Washington Acad. Sci., J.* 26. *pp.* 267–289, *July* 15, 1936.—The view may be tentatively entertained that earth currents are in the main induced by magnetic variations, but that their strength and duration depend upon the distribution and configuration of oceans and continents as well as upon other structural features of the earth. Modifications produced in earth-currents by the deep structure of the earth's crust may thus afford information about conditions in that little-known region. The magnetic forces which, on the view just outlined, induce the earth-currents, have their immediate origin in the high atmosphere in about the same region which reflects radio waves. One might expect to find in the earth a general system of electrical circulations related to that in the higher atmosphere. It has recently become possible to construct, on the basis of observed data, a world picture of earth currents. A world-view is summarised of the gross aspects of the quiet period earth-currents, comprehensively interpreting the tranquil electric messages from the earth. J. E. B.

4628. Secret of Earth-Currents. A. Nippoldt. *Terr. Mag.* 41. *pp.* 261–263, *Sept.*, 1936.—A summary is given of the main facts relating earth-currents and terrestrial magnetism. Local differences in general character and magnitude of the diurnal variation of the earth current occur from month to month and year to year, and even for stations quite near, and the type of earth current variation is often different from that for terrestrial magnetism except on disturbed days. No near relation exists for direction or magnitude at different places with magnetic or geographic latitude and the structure and resistivity of the earth and distribution of land and water are important. R. S. R.

See also Abstracts 4903, 4907.

RADIOACTIVITY.

4629. Co-precipitation of Minute Quantities of Foreign Substances. N. Riehl. *Zeits. f. phys. Chem.* 177. *Abt.A.* 3. *pp.* 224–234, 1936.—The ratio R of Ra to Ba in deposits as sulphate from solutions containing the two ions its value has been determined under varying conditions. When slowly crystallised from a saturated solution R in each successive layer is the same as in the solution at the time of deposition, *i.e.*, Doerner and Hoskins' logarithmic rule is followed. When slowly crystallised from a supersaturated solution R in the whole crystal is proportional to that in the final solution, the ratio in the crystal gradually changing after first deposition, *i.e.*, the Nernst-Berthelot rule is followed. Lastly, rapid crystallisation from a supersaturated solution (due to the presence of many crystallisation germs) follows the Doerner-Hoskins rule but with a somewhat different distribution constant. [See Abstract 172 (1931).] C. A. S.

4630. Extreme Distances in Radioactive Emissions. E. J. Gumbel. *Comptes Rendus,* 203. *pp.* 354–357, *Aug.* 3, 1936.—From probability considerations a formula for the extreme distances in radioactive emissions is derived and the results are tested by measurements on the α-particles from Po. An ionisation chamber is used, the discharge being amplified and registered on a relay in the usual manner. Good agreement was obtained between experiment and theory based on the "greatest value" principle. F. C. C.

4631. Absolute Velocity of α-Particles from Radium C′. G. H. Briggs. *Roy. Soc., Proc.* 157*A*. *pp.* 183–194, *Oct.* 1, 1936.—Precision measurements of $H\rho$ for the α-particles from Ra C′ are described in which the probable experimental error is estimated to be $2\cdot5$ in 10^5; uncertainty in the ratio of the international to the absolute ampere increases the probable error to 4 in 10^5. From this result and the value of the faraday and the atomic weight of the He nucleus the velocity and energy are calculated. AUTHOR.

4632. β-Ray Spectrum of Radium E. P. C. Ho and M. H. Wang. *Chinese J. of Physics,* 2. *pp.* 1–9, *April,* 1936. *In English.*—The β-ray spectrum of RaE is investigated by cloud chamber experiments. About 600 tracks with $H\rho$ above 2000 are obtained. The spectrum is found to have an end point at 7500 $H\rho$. The average energy per disintegration is estimated to be $4\cdot01 \times 10^5$ eV. AUTHORS.

4633. Precise Measurement of Three Radium-B β-Particle Energies. F. T. Rogers, Jr. *Phys. Rev.* 50. *pp.* 515–523, *Sept.* 15, 1936.—The $H\rho$ of the three most intense Ra B β-particle lines have been measured by a precise magnetic spectrograph method and found to be 1406·0, 1671·1, and 1931·5 gauss cm. An explicit analysis has been made of the Cotton balance equations for H in this experiment and on the basis of this a complete analysis was made of the maximum relative error to be expected in the accepted values of $H\rho$. It is shown that the maximum relative error to be expected in the least $H\rho$ is 1 part in 3000 and that within this possible error the greatest $H\rho$ agrees with the value obtained by Scott [see Abstract 4956 (1934)]. It is suggested that the accuracy of 1 part in 10,000 hoped for by Scott is rather too optimistic.

The energies of these three β-particles are 1·512, 2·044, and 2·610 in units of 10^5 eV. It is shown that the least of these cannot be expected to be any more accurate than 1 part in 1000. The conclusion is that except for systematic errors which might have been present and undetected throughout this experiment and that of Scott, these experiments have established the values of these Hρ's to within 1 part in 3000. AUTHOR.

4634. Excitation of γ-Rays by Neutrons from Ra + Be. S. Kikuchi, H. Aoki and K. Husimi. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 297–304, *July*, 1936. *In English.*—A discrepancy exists as regards the cross-sections of different elements for γ-ray production by the impact of neutrons in the results of the authors and of Lea [see Abstracts 2666 (1936) and 3416 (1935)]. A suggestion that this is due to the different energies of the neutrons has been examined by using as source thereof $RaBr_2$ + Be in a tube surrounded by 15–20 cm. Pb, the counter and substance acted on being surrounded by B_2O_3, forming a source about 1/10th as powerful as that previously used. The results, which agree closely with those previously obtained, give no support to the suggestion. Other possible explanations of the discrepancy are discussed. C. A. S.

4635. Secondary γ-Radiation Produced by β-Rays of UX and RaE. E. Stahel and P. Kipfer. *Helv. Phys. Acta*, 9. 6. *pp.* 492–506, 1936. *In French.*—The source of β-rays is UX_2 or RaE on Al leaf (0·01 mm. thick) and enclosed in a screen of various material forming the radiator. Between the radiator and the ionisation chamber (containing CO_2 at 16 atmospheres) are placed varying thicknesses of Pb. Plotted against the atomic number of the material of the radiator the intensity of the secondary (" deceleration ") radiation R_s is a linear function of the atomic number, but it does not vanish for Z = 0, there being a certain amount of primary γ-radiation, R_p. R_s is apparently composed of soft and hard portions in the ratio 40 : 60 and with $\mu_{Pb} = 2\cdot66$ and $1\cdot0$ cm^{-1}. respectively. R_p has $\mu_{Pb} = 0\cdot75$ cm. [See Abstract 3415 (1935)]. About 1·9 % of the energy of β-rays of UX of energy $> 0\cdot8 \times 10^6$ ev. is transformed into R_s, and 4·5 % (3·8 % if γ-rays of UZ be considered) into R_p. Results with RaE are generally similar, R_p and R_s (both heterogeneous) have $\mu_{Pb} = 1\cdot2$ and $1\cdot6$ cm^{-1}. respectively, and R_s is about seven times as intense as R_p, as against about 1·06 times in the case of UX. The results are discussed at length, and it is considered probable that in both cases R_p is due to internal, R_s to external deceleration. Alternative explanations are also suggested. C. A. S.

4636. Continuous γ-Radiation Accompanying β-Decay. F. Bloch. *Phys. Rev.* 50. *pp.* 272–278, *Aug.* 15, 1936.—Combining Fermi's theory of β-decay with the ordinary principles of quantum electrodynamics the continuous radiation, to be expected from the acceleration of charges during the nuclear decay, can be treated. Formulæ for its spectral distribution and its total intensity are developed, applicable to light elements, where the effect of the nuclear Coulomb-field on the electrons can be neglected. The relative amount of energy, liberated in the form of radiation, increases monotonously with increasing total energy; in the case of radioactive boron it amounts to about 0·6 %. AUTHOR.

See also Abstracts 4443, 4444, 4602, 4678, 4685, 4686, 4753, 4823, 4824, 4825, 4826.

RADIATION.

ABSORPTION AND TRANSMISSION.

4637. Spectrophotometric Study of the Hydrolysis of Ferric Salts. J. Cathala and J. Cluzel. *Comptes Rendus*, **203.** *pp.* 401–403, *Aug.* 10, 1936.—The classical theory attributes the variation in colour of solutions of ferric salts with pH value to the formation of $Fe(OH)_3$. This is tested spectrophotometrically. For very dilute solutions the concentration is given by log $[Fe(OH)_3] = 3$ pH + const. The logarithm of the product of the concentration and absorption coefficient is plotted against the pH value for a number of wave-lengths. The curves are parallel showing the absorption is due to one substance but their slope of 1/2 to 1/3 shows that this is not $Fe(OH)_3$. H. G. C.

4638. Anomalous Optical Constants of Silver. H. Murmann. *Zeits. f. Physik*, 101. 9–10. *pp.* 643–648, 1936.—Using the data of Goos [see Abstract 2669 (1936)] for transmissivity and reflection data, refraction and absorption coefficients of Ag deposits of different thicknesses have been measured between 1050 and 265 mμ. For massive layers of Ag considerable deviation is shown for these constants but the characteristic proper vibrations are exhibited right down to the thinnest layers. W. R. A.

4639. Transparency of Fused Silica in the Extreme Ultra-Violet. J. Terrien. *Rev. d'Optique*, 15. *pp.* 258–262, *Aug.*, 1936.—By a simplified photographic photometer method the coefficient of absorption of various samples of fused silica have been measured in the Schumann region. The transparency has been found to be better and more constant than for samples tested hitherto. Very thin layers of fused silica which had a sufficient transparency were tested also up to a wave-length of 1460 Å. The results indicate that with modern manufacture a certain constancy in the product is now being attained. R. S. R.

See also Abstracts 4429, 4667.

COLORIMETRY.

4640. Colorimetric System of the International Commission on Illumination. G. Ribaud. *Rev. d'Optique*, 15. *pp.* 161–181, *May*, 1936.—Gives an explanation of the underlying theory of colorimetry and of how this has led up to the internationally agreed (C.I.E.) system based on a "standard" observer. The tables in which the characteristics of this standard observer have been incorporated are reproduced in the paper and the formulæ for the three standard sources are given. The application of the data to the determination of the trichromatic coefficients for any particular coloured light is explained and it is pointed out that the data cannot be applied when the conditions differ considerably from those postulated, *e.g.*, in the case of point sources of light. [See following Abstract.] J. W. T. W.

4641. Colorimetry of Signal Glasses. J. Escher-Desrivières. *Rev. d'Optique*, 15. *pp.* 182–192, *May*, 1936.—Shows how the international colorimetry data [see preceding Abstract] may be applied to calculate the trichromatic coefficients for such glasses as railway or traffic signal glasses used in conjunction with any specified source. The transmission factors may also be found as described in the paper. The limitations of the C.I.E. data and the differences which may be introduced owing to a change of conditions (*e.g.*, size of the light source) are pointed out. J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4642. Optical Properties of Non-Polar Liquids. H. Mueller. *Phys. Rev.* 50. *pp.* 547–559, *Sept.* 15, 1936.—A theory of the refraction, Kerr effect and light scattering for liquids with non-polar axially-symmetric molecules is developed. The molecules are assumed to possess limited freedom of rotation, and account is taken of their quasi-crystalline grouping producing an anisotropic polarisation field, which is calculated by combining the classical cavity method with Ewald's lattice theory. The observed differences between the optical properties in liquid and gaseous states can then be explained. The theory is applied to benzene for which it leads to the same anisotropy of the Lorentz force and the same height of the potential barrier when derived from the molar refraction, its dispersion and its dependence on temperature and pressure, or from intensity and depolarisation of scattered light, and its frequency dependence, or from the Kerr constant and its variation with temperature and frequency. C. B. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4643. Polarisation of the Bands of Fluctuation of Zinc Vapour Fluorescence. M. Okóń. *Acta Physica Polonica*, 4. 3. *pp.* 215–218, 1935. *In French.*—Kapuściński has found in the fluorescence of zinc vapour a band extending from 3080 to 2400 Å possessing a fluctuating structure and similar to the bands of van der Lingen in Cd vapour and of Steubing in Hg. The author has found that the Kapuściński band, like the van der Lingen and Steubing bands, is partially polarised, and to about the same extent. J. E.

4644. Fluorescence of Rhodamine. G. R. Fonda. *J.O.S.A.* 26. *pp.* 316–322, *Aug.*, 1936.—The quantum yield and fading under visible light of the fluorescence of rhodamine films in solid solution in various plastics are investigated. The greatest efficiency is obtained with a 30 % solution of cellulose acetate in acetone containing 0·2 gm./l. of rhodamine. The optimum film thickness is 0·014 cm. The decrease in efficiency at greater concentrations is attributed to resonance and at greater film thickness to internal absorption. Fading of the film under the action of visible Hg light follows the same law as the variation in fluorescence with film thickness. The fading is due to the progressive destruction of rhodamine and is least in cellulose acetate and formvar. It is decreased by substitution of a C_2H_5 group or K for the H attached to the COOH group. H. G. C.

4645. Infra-Red Fluorescence of Living Geranium Leaves. C. Dhéré and O. Biermacher. *Comptes Rendus*, 203. *pp.* 412–414, *Aug.* 10, 1936.—The fluorescence of living geranium leaves [see Abstract 2505 (1935)] is extended and bands with centres at 8120, 7400, and 6850 Å are recorded and compared with those of chlorophylls (*a*) and (*b*). The effects in the photography of green leaves with filters passing $\lambda > 8000$ Å are attributed to the reflection due to cellulose. H. G. C.

4646. Fluorescence of Chlorophyll in its Relation to Photochemical Processes in Plants and Organic Solutions. J. Franck and R. W. Wood. *J. Chem. Phys.* 4. *pp.* 551–560, *Sept.*, 1936.—The intensity of the fluorescence of chlorophyll in organic solutions and its variation with time of illumination are attributed to the predissociation of the chlorophyll or the photo-oxidation of acceptor molecules for O_2. The relationship between the intensity of the fluorescence in leaves and the time of illumination is plotted for a number of conditions and the lifetime of the radical H-Chph-R is measured. The results are again explained by a photo-oxidation sensitised by chlorophyll in addition to photosynthesis. H. G. C.

4647. Negative Polarisation of Phosphorescence. A. Jabłoński. *Acta Physica Polonica,* 4. 3. *pp.* 311–324, 1935. *In German.*—After a preliminary reference to previous work on the polarisation of the phosphorescence of cellophane phosphors [see Abstracts 3421 and 4221 (1935)] a detailed account is given of a new arrangement for measuring the degree of polarisation of phosphorescence with precision. Investigations were made with cellophane phosphors containing trypoflavin, euchrysin and rhodulin yellow and with isotropic cellon dyed with euchrysin. In the latter case the phosphorescence is only present at liquid-air temperature and the emitted light only polarised when excited with polarised light. Also in the case of the isotropic cellon the degree of polarisation is often independent of the azimuth of the plate while with the doubly-refracting cellophane it depends markedly on the azimuth. In the latter case the maxima occur at the same azimuths for the F → N band as for the M → N band, but the polarisation for the second is always negative (component perpendicular to vibration of exciting light greater than component parallel to it). A theoretical discussion is given based on the assumption of anisotropic orientation of the adsorbed dyestuff molecules under the influence of an anisotropic effective field of the exciting light in the doubly-refracting medium. J. E.

See also Abstract 4817.

INTERFERENCE. DIFFRACTION AND SCATTERING.

***4648. Experiments with Convergent, Divergent and Parallel Light Beams on a Plane Grating. D. L. Das.** *Zeits. f. Physik,* 102. 3–4. *pp.* 272–278, 1936.—The experimental arrangement described in a previous paper [see Abstract 4134 (1936)] is modified by placing the lens between grating and slit, instead of between grating and microscope. Thus the light beam passing the grating is convergent. In this arrangement it is possible to measure directly the angle of diffraction for the principal ray of a diffracted beam and also the distances of diffracted and undiffracted image from the grating. The theory is extended so as to take the finite thickness of the glass grating into account. The results are confirmed by measurements. R. P.

4649. Phase Difference in Fraunhofer Diffraction Phenomena. J. Picht. *Zeits. f. Instrumentenk.* 56. *pp.* 363–368, *Sept.*, 1936.—The statement that the phase is the same in all the Fraunhofer diffraction images obtained in the focal plane of the lens with a grating illuminated by plane waves (when the object is an " amplitude " grating) is criticised. C. B. A.

4650. Theory of Fraunhofer Diffraction. M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 5. *pp.* 89–91, 1936.—Kirchhoff's theory of diffraction involves a surface integral. Rubinowicz has shown that this can be transformed into a contour integral; his examples refer to Fresnel type diffraction. The author shows that the method is equally applicable to Fraunhofer diffraction and gives a more direct mathematical derivation. For rectilinear contours the resulting integral can be evaluated much more readily than the surface integral; for curvilinear contours, it is more suitable for numerical integration. T. L. M.

4651. Structure of Rayleigh Radiation from Liquids. K. Birus. *Phys. Zeits.* 37. *pp.* 548–549, *Aug.* 1, 1936.—In testing the presence and strength of the middle line [see Abstracts 1110 and 4506 (1934)] the author used the light of the Hg line λ4078. Polarisation measurements were also made, and the scattered light is found to be of two kinds: (1) a symmetrical triplet, completely polarised in the direction of the incident radiation, of which the intensity relation agrees with that given by Landau and Placzek; (2) the depolarised anisotropy radiation which in the echelon grating exhibits no structure and is strongly scattered. G. E. A.

*4652. **Diffraction Grating at Grazing Incidence. L. W. Alvarez.** *J.O.S.A.* 26. *pp.* 343–346, *Sept.*, 1936.—An experimental test of the grating law has been made by using a coarse, plane grating at grazing incidence, in a spectrograph similar to that used in the X-ray case. No deviations from the grating law were found which were as large as the experimental error of 0·02 %. AUTHOR.

See also Abstracts 4460, 4685, 4686, 4694, 4752, 4804, 4805, 4806.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4653. Photo-Decomposition of Acetone Vapour. J. P. Howe and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 58. *pp.* 1404–1412, *Aug.*, 1936.—The quantum yield of acetone decomposition with approximately monochromatic radiation from the aluminium spark about 1900 Å has been investigated. It is (*a*) independent of intensity over quite wide limits; (*b*) dependent upon acetone pressure, increasing at low pressures, the limiting value appearing to be about 0·65; (*c*) increases with the addition of N_2 and CO_2 and to a lesser extent with the addition of ethane; (*d*) is apparently increased by the action of excited mercury unless precautions are taken to avoid this error. No fluorescence could be detected. Some difficulty is encountered in explaining the low quantum yield at low pressures, but otherwise the facts fit a simple kinetic picture. The photodecomposition of acetone near 3000 Å, the decomposition near 1900 Å, and the various facts of spectroscopy and fluorescence may mostly be correlated with the use of potential energy surfaces. AUTHORS.

4654. Photochemistry of Nitrates, Nitrites and Nitro-Compounds. Part II. C. H. Purkis and H. W. Thompson. *Faraday Soc., Trans.* 32. *pp.* 1466–1474, *Sept.*, 1936.—Previous measurements [see Abstract 2152 (1936)] on the photochemistry and spectroscopy of nitrates, nitrites and nitro compounds are extended. A comparison is made with the data for nitrous acid recently reported by other workers, and interpretations are suggested to explain the structure of the regions of banded absorption in the nitrite spectra. The products of photochemical decomposition of the nitrites are described, and a mechanism is suggested to represent in general the course of this reaction. AUTHORS.

4655. Photographic Intermittency Effect in the Region of Extremely Short Flash Periods. J. H. Webb. *Kodak Research Lab., Comm. No.* 596. *J.O.S.A.* 26. *pp.* 347–353, *Sept.*, 1936.—Experiments were carried out to test the equivalence of intermittent exposures of the same average intensity for cases in which the flash period varies over the range 10^{-8} to 10^{-7} sec. The exposures were made by means of a mirror mounted on top of a high speed air turbine. The results are in agreement with those obtained in former investigations made at longer flash times to the effect that above the fusion frequency of flash, intermittent exposures of the same average intensity are independent of the speed of flash. [See Abstract 2965 (1933).] AUTHOR.

4656. Grain Size and Capacity for Enlargement of Microphotographs. F. Buchthal and G. G. Knappeis. *Zeits. f. wiss. Phot.* 35. *pp.* 177–192, *Aug.*, 1936.—Nine commercial emulsions have been studied by means of microphotographs and photometric measurements of single grain layers for evaluating grain size, distance and distribution. The results obtained are relative for each emulsion, since only one surface of the layer is examined. For confirming the utility of photometric analysis, the optical single grain layers were evaluated for all the emulsions investigated from plans and planimetric measurements of at least 100 grain-aggregates, and the average area of the single aggregates was directly computed. The agreement between the two methods was exceptionally good. A simple relationship between capacity for increase and the microphotographically-photometrically determined properties of the emulsions could not be found from the comparison of different negatives. The comparison of the average values of all the highly sensitive emulsions investigated with the corresponding factions of the diapositive plate, shows that the factors do not equally influence the capacity for increase, but that the area of the separate grain aggregate plays the greatest rôle. H. H. Ho.

4657. Desensitisation. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 35. *pp.* 197–200, *Aug.*, 1936.—Deals briefly with the theory of desensitisation as indicated by the marked differences between collodion and gelatin emulsions, considering also recently published results. R. C. F.

4658. Adsorption Photography. F. L. Burmistrov. *Phot. J.* 76. *pp.* 452–459, *Aug.*, 1936.—Washed-off photographic plates, when again coated, exposed and developed, show ghost images from previous exposures, especially when the original images were physically developed. Experiments described indicate that this is due to a film of light-sensitive silver silicate adsorbed to the thin layer of silica gel present on the surface of the glass. A glass plate bathed in silver nitrate is thus light-sensitive and the image may be built up by prolonged physical development, while the sensitivity may be increased by prior conversion of the silver silicate to silver halide which may then be treated with sensitising dyes. The thickness of the silica gel film depends upon the composition of the glass and may be modified by suitable bathing treatment. The resulting silver image is of extremely fine grain (resolving power = 2000); the immediate application is thus the production of graticules, though others are envisaged, notably the preparation of thin metal coatings of the type normally produced by kathodic sputtering. L. V. C.

4659. Spectral Sensitivity of Photographic Layers. G. Gorochowsky and E. Waliaschko. *Techn. Phys., U.S.S.R.* 3. 6. *pp.* 528–540, 1936. *In German.*—The spectral sensitivity of photographic plates is measured by means of a glass prism spectrograph and thermocouple.

The absolute energy values in the spectrum between 420 and 1200 $m\mu$ are obtained. The spectral sensitivity for light of a definite wave-length is the reciprocal of the light quantity in ergs/cm^2. which, after development, produces a blackening density of 1·0 when allowance is made for the effect of fog. Spectral sensitivity curves for a number of photographic materials are given and compared with the stated general sensitivity for daylight. R. C. F.

***4660. Apparatus for the Measurement of the Resolving Limit of Emulsions. A. Charriou and Suzanne Valette.** *Soc. Franç. Phot. et Ciné, Bull.* 23. *pp.* 81–87, *April*, 1936.—An instrument called a sensito-resolumeter is described for the measurement of the resolving limit of photographic emulsions. It consists essentially of a uniform light source, a rotating slit shutter and a camera. Ten separate images may be obtained on 1 plate by means of an auxiliary attachment on the camera. The time of exposure and intensity of illumination of an object may be varied by suitable adjustments. By the use of a special Zeiss lens of focal length 85 mm. and aperture 1/4, it is possible to measure limits of resolution to 0·01 mm. when the camera is arranged to reduce the image of the object by 20 times. Great care must be taken in mounting the instrument free from vibration and a system which enables this to be done is described. H. J. H. S.

4661. Thallium Bromide Emulsion. W. J. G. Farrer. *Phot. J.* 76. *pp.* 486–491; *Disc.*, 491–492, *Sept.*, 1936.—Deals with the latent image on thallium salts. After briefly describing the preparation of thallium bromide emulsion, the development of the emulsion and the effect of iodide are considered. As the emulsion is slow, attempts to increase speed are described and the influence of gelatin is considered. Finally, colour sensitising, the transference and stability of the latent image, and the recovery of Tl are discussed. In the *Discussion*, **L. V. Chilton** suggested that bathing in $AgNO_3$ simply coated the TlBr with a surface skin of AgBr, but this was stated to be incorrect there being no Tl present after bathing. **E. R. Davies** said that during conversion it was possible for the latent image to be partially submerged thus accounting for the slower speeds. R. C. F.

4662. Monochrome Reproduction in Photo-Engraving. A. Murray. *Kodak Research Lab., Comm. No.* 585. *Phot.* J. 76. *pp.* 440–451, *Aug.*, 1936.—In a study of reproduction from a 150-line half-tone copper photo-engraving, the measured reflection densities of the printed copy have been compared with the densities calculated from the dimensions of the dots on the plate and on the print, making certain assumptions concerning the distribution of ink over the printed dot and the D_{max} of the ink. There occurs on printing a spread of the dot which is a function of dot size and shape, and is moderately reproducible. This has a greater effect on the reproduction curve than changes in D_{max}. Values of D_{max} greater than 1·6 are normally obtainable only by varnishing the print. It is established that reflection density measurements are applicable to structured images of this type and that the ideal reproduction curve is the same for such images as for continuous-tone images. L. V. C.

***4663. Construction of 16-mm. Film Apparatus. H. Lummerzheim.** *V.D.I.* 80. *pp.* 913–917, *July* 25, 1936.—Discusses the fundamental principles of the construction of apparatus for 16 mm. films dealing with the film camera and projection apparatus, considering projection, illumination and optical arrangements and electrical equipment. Finally, the use of small sound and colour films is briefly dealt with. R. C. F.

***4664. Effectiveness of Photographic Light Sources. W. E. Forsythe and (Miss) M. A. Easley.** *J.O.S.A.* **26.** *pp.* **310–312,** *Aug.*, **1936.**—The authors compare six special types of lamps, viz., 3 photoflash and 3 photoflood ratings, with a regular tungsten lamp to determine the relative effectiveness of each type when used with five different kinds of emulsion. The special characteristics of each lamp are described and in particular the time-intensity curves are given for each of the photoflash lamps. The radiation from a No. 20 photoflash lamp has approximately the same distribution as that from a black body at 3500° K. The photofloods operate at colour temperatures between 3430° and 3490° K. J. W. T. W.

4665. Definition and Image-Separation in Stereoscopy. C. W. Wilman. *Phot. J.* **76.** *pp.* **482–485,** *Sept.*, **1936.**—Derives formulæ for the determination of the limits of distance corresponding to any given range of stereoscopic separation, the relations of these limits to the distance upon which the lenses are focused, and the stop necessary to give adequate definition over the entire range. The application of the formulæ in practice is also indicated. R. C. F.

4666. Measurement of Gloss on Photographic Papers. A. Klughardt. *Phot. Indust.* **34.** *pp.* **761–762,** *July* **8,** *and pp.* **792–793,** *July* **15, 1936.**—Briefly describes the results obtained for gloss values of glossy, satin and matt photographic papers, the method used involving the photometry of normally reflected light, the angle of incidence being 45° and the sample horizontal, and with the sample turned through small angles up to 22·5°, the photometer axis remaining unchanged. R. C. F.

See also Abstracts **4645, 4646, 4667, 4673, 4735, 4867, 4893.**

PHOTOMETRY.

***4667. Calculation of Filters for Colour-Temperature Conversion. K. S. Weaver.** *Kodak Research Lab. Comm. No.* 597. *J.O.S.A.* **26.** *pp.* **339–342,** *Sept.*, **1936.**—Filters for the conversion of the colour temperature of a source of radiant energy from one value to another are of considerable importance in photography and photometry. After dealing briefly with the theoretical aspects of the problem, a chart is given, which is used in the determination of the ideal characteristics of filters for particular conversions, or in the estimation of the quality of a given filter from its spectrophotometric curve. The method of using the chart is briefly indicated, and, finally, the theoretical transmission of an ideal black-body conversion filter is examined. R. C. F.

***4668. Bimetallic Strips in Radiation Measurements and in Photometry. H. Klumb.** *Zeits. f. techn. Physik*, **17. 8.** *pp.* **279–280, 1936.**—Two forms of an apparatus for measuring the intensity of radiation by the use of bimetallic strips, are described; one employing the strips in a straight form and one in a spiral form. Although the bimetallic strips, which are composed of iron and nickel, are quite robust, sufficient sensitivity (about 10 erg/sec./scale div. at 1 m.) is obtained to make the instrument useful as a photometer, as well as for the measurement of optical constants in the visible and in the infra-red, and, finally, as a pyrometer. G. O. B.

***4669. Standardisation of Photo-Cells for the Measurement of Energy. H. H. Poole and W. R. G. Atkins.** *Roy. Dublin Soc., Proc.* 21. *pp.* 363–379, *Aug.*, 1936.—A method is described for standardising photo-cells with colour filters for the measurement of the energy in different parts of the spectrum. This is effected by means of a standard tungsten-filament lamp at a rated colour temperature of 2360° K. The calculation of the radiant power or energy per sec. in various spectral blocks isolated by means of the filters is considered in detail, and from the resulting currents, corrected for the "curvature" error of the rectifier cell used, the constants for the various spectral regions are obtained. The effect of uncertainties in the temperature scale adopted is considered. An application of the constants so obtained to some daylight readings shows certain anomalies which suggest that further investigation of the method is desirable. The method is a comparatively simple one for the approximate standardisation of photo-cells in power units, but owing to the relatively low temperature of the standardising source and some uncertainties as to the scale the results so far obtained may possibly contain errors as large as 20 %. AUTHORS.

See also Abstracts 4637, 4750.

POLARISATION.

4670. Anisotropy of the Optical Polarisation Field in Liquids. Parts IV and V. B. S. R. Rao. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 64–73, *July*, 1936.—The molar refractivity is measured at different temperatures for two isomers (*n*-butyl alcohol and ethyl ether) and three consecutive members (pentane, hexane and heptane) of a homologous series. In all these cases, except butyl alcohol, the molar refractivity is found to increase with temperature thus showing that the optical polarisation field is not of the Lorentz type but should be regarded as anisotropic. In butyl alcohol, the molar refractivity at first slightly increases and then diminishes. In these respects it resembles an associated liquid. In the series pentane, hexane and heptane, the ratio of the coefficients p_2 and p_1 which constitutes a measure of the anisotropy of the optical polarisation field is found to increase on ascending the series and the deviations from the Lorentz law are also more marked in heptane than in hexane and pentane. With rise of temperature p_2/p_1 rapidly approaches unity in all these cases except butyl alcohol. In Part V the values of p_2/p_1 in the case of 8 different liquids at different temperatures are collected for purposes of convenient comparison. [For Part III see Abstract 3167 (1936).] AUTHOR.

4671. Absorption and Circular Dichroism of Camphorquinone. T. M. Lowry and (Miss) D. M. Simpson. *Chem. Soc., J. pp.* 1156–1159, *Aug.*, 1936.—The absorption and circular dichroism of camphorquinone have been measured in solutions in *cyclo*hexane. The curve of circular dichroism resembles a parabola, with a smoothly-rounded maximum, $\epsilon_r - \epsilon_l = 1\cdot95$ at 4700 Å, but it is definitely steeper on the side of longer wave-lengths. The visual absorption band rises to a maximum, $\epsilon = 38\cdot8$ at 4780 Å, but a second band of very small persistence was discovered in the ultra-violet with a maximum $\epsilon = 23$ at 2650 Å. The principal component of the visual absorption is the optically active band, of which the circular dichroism was recorded; but the form of the absorption curve is much less regular, and can only be interpreted by assuming the presence of optically inactive components on either side of the main component. These inactive components are shown tentatively with maxima $\epsilon = 9\cdot4$ at 4900 Å, and $\epsilon = 11\cdot4$ at 4230 Å. AUTHORS.

***4672. Spectropolarimeter for the Schumann Region. R. Servant.** *Comptes Rendus,* 203. *pp.* 311–312, *July* 27, 1936.—The spectropolarimeter previously described [see Abstract 1617 (1936)] has been modified by mounting it in an evacuated enclosure. Details are given and it is stated that satisfactory photographs are obtainable down to a wave-length 1300 Å, practically the limit set by the fluorite window of the bulb enclosing the light source. W. S. S.

***4673. "Polaroid" Light-Polarising Material.** *Engineering,* 142. *pp.* 235–236, *Aug.* 28, 1936.—Deals briefly with the manufacture and uses of a new polarising material, known as "Polaroid," which consists of a cellulose film usually mounted between two glass plates, the whole area of the film acting as a single crystal. The uses referred to are the detection and analysis of strains in transparent materials, photographic uses, and the elimination of glare from motor-car headlights. R. C. F.

***4674. Measurement of Small Retardations with the Polarising Microscope. R. S. Bear and F. O. Schmitt.** *J.O.S.A.* 26. *pp.* 363–364, *Sept.,* 1936.—A modification of the Köhler method is described which facilitates the measurement of the small retardations frequently found in minute biological objects. AUTHORS.

See also Abstracts 4642, 4643, 4647, 4651, 4687, 4745, 4746, 4748.

RADIATION, EMISSION.

4675. Spectral Distribution of Radiation from Tungsten-Filament Lamps. B. T. Barnes and W. E. Forsythe. *J.O.S.A.* 26. *pp.* 313–315, *Aug.,* 1936.—Gives tables of the spectral distribution of the energy emitted by a number of tungsten-filament lamps of different types ranging in colour temperature from 2760° to 3475° K. The figures are expressed as μW/cm.^{2} at 1 m. for a wave-length band of 50 Å and the spectral range covered is 3500 to 26,000 Å, although there is considerable absorption in the glass envelope from 25,000 Å onwards. The spectral radiation from tungsten ribbon operating at various colour temperatures from 2150° to 3300° K. is also tabulated from 3500 to 40,000 Å. J. W. T. W.

4676. Barometric Fluctuations of Penetrating Radiation Showers. W. Messerschmidt. *Phys. Zeits.* 37. *p.* 557, *Aug.* 1, 1936.—Previous experiments by various workers having shown the large effect of water vapour in the atmosphere on the production of cosmic-ray showers, a controlled experiment was devised in which an ionisation chamber of 24·5 l. capacity, filled with air at 26 atm. was surrounded by a lead screen 5 cm. thick and surmounted by a chamber containing water to a variable depth up to 10 cm. Observation of the frequency of shower production with increasing depth of water showed a sharp rise to a maximum at about 2 cm. after which a gradual decrease occurred. Although the results might be attributed to the presence of neutrons, detailed examination shows such an explanation to be attended by many difficulties. F. C. C.

4677. Resolution of Coincidences with Tube Counters. W. Christoph. *Phys. Zeits.* 37. *pp.* 558–559, *Aug.* 1, 1936.—Using tube counters 10 cm. long, 2·5 cm. dia. and filled with H_2 or O_2 at 62 mm. Hg, the resolution of coincidences produced by penetrating radiation when the counters are 6 cm. apart is examined. The results show that with H_2 the time of resolution is less than 10^{-5} sec. but with O_2 it is considerably larger and uncertain. F. C. C.

4678. Theory of Penetrating Radiation Showers. W. Heisenberg. *Zeits. f. Physik,* 101. 9–10. *pp.* 533–540, 1936.—Fermi's theory of β-ray disintegration is applied to give a qualitative explanation of the production of penetrating radiation showers. The great difficulties involved by the introduction of the universal length in Fermi's theory are discussed.

F. C. C.

***4679. Absorption Curve of Cosmic Radiation in Lake Constance. F. Weischedel.** *Zeits. f. Physik,* 101. 11–12. *pp.* 732–754, 1936.—A new ionisation chamber is described by means of which the residual ionisation at great depths of water can be further reduced. The important new features are: High pressure (28 atm.), large volume (114 l.) and a number of details, *e.g.*, shielding of the dry battery which supplies the current for illumination, as this was found to give off emanation. The ionisation curve is given down to 235 m. depth. The value at this depth is only 0·5 % of that at sea level. Of this value, probably 1/3 is due to the residual ionisation of the apparatus, while the rest is due to very penetrating cosmic rays. At depths of more than 90 m. the frequency of large bursts can be found from the registration of the electrometer, and preliminary figures are given for the decrease of the frequency of bursts with depth. Some evidence for a seasonal variation of cosmic-ray intensity was obtained. R. P.

4680. Cloud-Chamber Observations of Cosmic Rays at 4300 M. and Near Sea-Level. C. D. Anderson and S. H. Neddermeyer. *Phys. Rev.* 50. *pp.* 263–271, *Aug.* 15, 1936.—Cloud-chamber photographs at 4300 m. elevation show positive and negative electron tracks similar to those observed at sea-level, but positive-negative electron showers occur more frequently and, in general, consist of more numerous tracks. Showers of 2–4, 5–10, and 11–100 tracks occur respectively, 8·6, 21 and 29 times as frequently at 4300 m. as they do near sea-level. Further measurements on the energy loss in lead of electrons up to 400 eMV are given. They show that in this range of energies the energy loss in lead is roughly proportional to the incident energy. About 1 % of the exposures on Pike's Peak reveal the presence of strongly ionising particles which in most cases seem to be protons. The proportion of such tracks is considerably greater than at Pasadena. These heavy tracks in general bear only little relation in direction to that of the incoming beam, and usually arise from a type of nuclear disintegration not heretofore observed. The energies of these heavily ionising particles may rise to values so high as 150 eMV, thus indicating that the source of the particle energies is in the cosmic rays.

AUTHORS.

4681. Search for Protons in the Primary Cosmic-Ray Beam. C. G. Montgomery, D. D. Montgomery, W. E. Ramsey and W. F. G. Swann. *Phys. Rev.* 50. *pp.* 403–407, *Sept.* 1, 1936.—Using Bethe's theory, the number of bursts of ionisation to be expected due to protons of the cosmic-ray beam terminating their path in the ionisation chamber used as detector is calculated. To eliminate α-particles the ionisation chamber was divided into two halves by horizontal partition, and only bursts occurring simultaneously in both halves were counted. Bursts produced by "showers" were recognised and eliminated by suitably arranged Geiger counters. The results give an upper limit for the number of protons present as 5 % of the total number of cosmic-rays at sea-level.

F. C. C.

4682. Allowed Cone of Cosmic Radiation. G. Lemaître and M. S. Vallarta. *Phys. Rev.* 50. *pp.* 493–504, *Sept.* 15, 1936.—Further results of an extensive study of trajectories asymptotic to a known family of unstable periodic orbits in the earth's dipolar magnetic field, carried out by means of Bush's differential analyser, are presented in this paper. A detailed discussion is given of our methods of determining asymptotic trajectories by means of the differential analyser and by numerical integration of a whole family at a time; comparison of the results obtained shows the absence of systematic errors of any consequence in the mechanical integrations and exhibits the precision attained with the differential analyser. The families of asymptotic trajectories are then analysed systematically in order to determine the main cones for latitudes up to 30°. This leads to the theory of the azimuthal effect and a study of the region in the vicinity of the zenith. [See also Abstract 3175 (1936.] AUTHORS.

4683. Coincidence Counter Measurements of Cosmic Rays in an Aeroplane. H. J. Braddick and C. W. Gilbert. *Roy. Soc., Proc.* 156A. *pp.* 570–577, *Sept.* 1, 1936.—Measurements of cosmic rays (vertical intensity and shower production) have been made in an aeroplane at a height of 30,000 ft. corresponding with a barometric pressure of 220 mm. The absorption of the vertical rays in 3 cm. lead was measured and a rough transition curve was obtained for the shower production in lead. The showers increase with altitude much more rapidly than the vertical intensity. The radiation at high altitude contains a large proportion of soft radiation absorbed in a few cm. of lead. AUTHORS.

4684. Triple Coincidence Measurements of Vertical Intensity of Cosmic Radiation in Stratosphere. G. Pfotzer. *Zeits. f. Physik*, 102. 1–2. *pp.* 23–58, 1936.—Self-recording apparatus was sent up on three ascents of a free balloon, measurements thus being obtained down to 10 mm. of Hg. The curve of coincidence-rate against air-pressure shows a maximum at 80 mm. and a hump at 300 mm. The results are interpreted in terms of a primary and secondary component of the cosmic radiation. Two kinds of particles are assumed for the primary component, following different absorption laws for the same energy range. The softer component (electrons or positrons) produces showers, the energy losses being proportional to the energy of the particle. The energy distribution, the range and the secondary intensity of this soft component are calculated. The harder component loses energy only through primary ionisation, and gives rise to the latitude effect at sea level. D. H. F.

See also Abstracts **4667, 4749, 4826, 4899.**

RADIATION, GENERAL THEORY.

4685. Experimental Verification of the Photon Theory. W. Bothe and H. Maier-Leibnitz. *Zeits. f. Physik.* 102. 3–4. *pp.* 143–155, 1936.—The experiment of Shankland [see Abstract 1241 (1936)] is repeated with a number of improvements: The γ-ray source is RaTh, filtered through 1 cm. Pb, instead of RaC, and thus the radiation is practically homogenous. The number of chance coincidences and of coincidences due to cosmic rays is determined experimentally instead of being calculated from the resolving time of the coincidence arrangement. For this purpose the scatterer is removed and the counting rate in each counter brought back to the same value as before by a suitable soft β-ray source whose particles cannot pass both counters and therefore produce no systematic coincidences. This determination of the spurious coincidences is always carried out with the counters in the same position as in the actual run, in order to ensure constancy of any coincidences that may be due to cosmic rays. The total number of counted coincidences was 215, while the average number of spurious coincidences in a run of equal length was found to be 78. Control experiments were made with the counters removed from the correlated positions and gave altogether 135 coincidences as against 108 spurious coincidences in a comparison run. This positive result is a confirmation of the photon theory. [See also Abstract 4753 (1936).] R. P.

4686. Conservation of Energy in Radiation Processes. E. J. Williams and E. Pickup. *Nature,* 138. *pp.* 461–462, *Sept.* 12, 1936.—Further experiments on the production of photoelectrons in argon gas by X-rays, support the quantum theory and the principle of conservation of energy, the applicability of which to X-radiation processes had been disputed, following upon the results of Shankland's experiments. [See Abstract 1241 (1936).] AUTHORS.

See also Abstracts 4548, 4743.

REFLECTION. REFRACTION AND DISPERSION.

4687. Effects of Elliptical Light and Orientation of the Polariser in Comparing Reflecting Powers with the Microscope. L. Capdecomme. *Comptes Rendus,* 203. *pp.* 312–315, *July* 27, 1936.—The author studies the production of elliptically polarised light by a right-angled prism used in the illuminator of the microscope. The use of an illuminator with two prisms crossed is shown to provide a compensated system even for white light. It is further found that elliptical polarisation is reduced to a minimum when the polariser is turned so that the incident vibrations are parallel or perpendicular to the plane of incidence of the mean ray reflected by the prism. W. S. S.

4688. Focal Relations between the Circular Conics to a Curve and Applications to Catoptrics. P. Rossier. *Arch. des Sciences,* 18. *pp.* 147–153, *May–June,* 1936.—A series of conics tangential to a curve is taken which pass through a selected point, and with their axes parallel to the normal to the curve at this point and with the point forming the vertex of the curves. The general properties of these curves are first examined and the relations are then applied to the theory of mirrors and to the special cases for the Gregory and Cassegrain reflecting telescopes. R. S. R.

4689. First-Order Laws in Asymmetrical Optical Systems. Part I. M. Herzberger. *Kodak Research Lab., Comm. No.* 592. *J.O.S.A.* 26. *pp.* 354–359, *Sept.,* 1936.—The theory of asymmetric optical systems, paralleling the Gaussian theory given earlier [see Abstract 4236 (1935)], is derived from the fundamental invariant using systematically the author's tetrality principle. In this part only the image of a given congruence is considered. A. H.

4690. Graphical Construction for a Refracted Ray. A. Bloch. *Journ. Sci. Instruments,* 13. *pp.* 302–303, *Sept.,* 1936.

4691. Analactic Point for a Telescope with Internal Focusing Lens. H. Schulz. *Zeits. f. Instrumentenk.* 56. *pp.* 357–360, *Sept.,* 1936.—For measurement of distance with the help of a slit with a special scale a constant K is used such that $K = f_0/p$, where f_0 is the focal length of the objective and p the scale distance. For the image distance s' one

obtains $s' = \mathrm{L}f_0/h = \mathrm{LK}$ and the equation $s' = s - f_0$ gives the definition of the analactic point. The definitions of Eggert and Haerpfer are considered and shown to be defective and an alternative definition is given.
R. S. R.

***4692. Mangin Mirrors. H. R. Schulz.** *Zeits. f. Instrumentenk.* 56. *pp.* 361–362, *Sept.*, 1936.—Aberrations of a Mangin mirror are investigated, and it is shown that the condition stated by Mangin for absence of spherical aberration is not strictly valid, but gives correct results when the thickness is very small. C. B. A.

***4693. Minimum-Deviation Refractometry and Temperature Coefficients for a Medium Flint Glass. L. W. Tilton.** *Bureau of Standards, J. of Research,* 17. *pp.* 889–900, *Sept.*, 1936.—Constructional details are given for a constant-temperature housing for minimum-deviation measurements on a spectrometer, and the operational procedure is described. Provision is made for mounting and properly adjusting the prism in a temperature-controlled bath of stirred air contained in a water-jacketed cylinder provided with plane-parallel windows that are adjustable for use over a wide range of prism angles and refractive media. Typical temperature coefficients of refractivity are given for a medium flint glass.
AUTHOR.

4694. Glass Surfaces in Optical Contact. (Lord) Rayleigh. *Roy. Soc., Proc.* 156*A*. *pp.* 326–349, *Aug.* 17, 1936.—The method of getting glass and silica plates into optical contact and the behaviour of scratches in hindering contact are discussed. Scratches made with a cutting diamond or steel wheel cutter raise a ridge on the glass while those made with a writing diamond (splinter) do not. A method to determine the mechanical work done in separating two contacted glasses is given and of the value found, 70 ergs/cm.^{2}, half can be recovered on recontacting. Very variable results are found for the pull required to separate two contacted glasses, the maximum being $4 \cdot 5 \times 10^7$ dynes/cm^2. Reflection from the interface between two contacted wedges of glass or silica is slight but measurable and varies from one specimen to another. The reflecting power is not affected by pressure but the cause of variation is not known. Reflection between silica glass and a liquid of equal index depends on the method of preparation of the surface and is being investigated. The black centre of Newton's rings between a lens and plate shows a residual reflection which varies in different specimens. In optical respects it behaves like the interface of glasses in adhesive contact. No definite information has been obtained for the distance between contacted faces but the intensity of reflection indicates a distance in some cases of less than 10 Å.
R. S. R.

See also Abstracts 4490, 4568, 4638, 4642, 4666, 4670, 4674.

SPECTROSCOPY.

4695. Spectrum of Trebly Ionised Cerium. R. J. Lang. *Canad. J. of Research,* 14. *Sect. A. pp.* 127–130, *July,* 1936.—The discovery of two members of the F series made it possible to obtain a fuller analysis of this spectrum. The following terms are located: 6S, 7S, 8S, 6P, 5D, 6D, 7D, 4F, 5F, 5G and 6G. Some thirty lines are classified. The deepest term, 4F, has an absolute value of approximately 296197 cm.$^{-1}$ based upon the three S terms and the use of a Ritz formula, giving an ionisation potential of $36 \cdot 5$ V. [See also Abstract 4250 (1935).] AUTHOR.

4696. Spectrum of Trebly Ionised Argon. T. de Bruin. *Physica,* 3. *pp.* 809–814, *Aug.,* 1936. *In English.*—Separation of the lines due to A III from those due to A IV has been made by regulation of a self-inductance in the circuit feeding the source. The terms are evaluated from the true frequencies, and compared with isoelectronic configurations. A. C. M.

4697. Spectrum of Ionised Calcium Produced by Encounters with Shock Waves. H. Muraour and A. Michel-Lévy. *Comptes Rendus,* 203. *pp.* 316–317, *July* 27, 1936.—The spectra of Ca produced by shock waves and from flames are compared. In the flame spectrum Ca is non-ionised; the shock wave spectrum shows that Ca is ionised. The differences are discussed. W. R. A.

4698. Energy and Velocity as Parameters for Excitation by Impact. W. Hanle and R. Junkelmann. *Phys. Zeits.* 37. *pp.* 593–594, *Aug.* 15, 1936.—The excitation of the He line 3888 by impact of H and D positive rays is measured for energies between 8 and 35 kV. It is found that a deuteron excites more radiation than a proton of the same velocity, but less than a proton of the same energy. The excitation of the Balmer lines in the same impact was observed. As a function of the energy of the hydrogen atom they show similar behaviour and a maximum at the same place but the intensity of the deuterium lines is always considerably greater. R. P.

4699. Light Excitation in Helium by Collision with Potassium Ions. W. Maurer. *Zeits. f. Physik,* 101. 5–6. *pp.* 323–334, 1936.—A source of K ions is described and its suitability for experiments in photo-excitation is investigated. Photo-excitation in He between 750 and 12,000 V was observed. The excitation functions of three He lines and a large number of K II lines were measured. W. R. A.

4700. Lifetimes of Potassium Doublets λ4047–4 and λ3447–6. D. Sinclair and H. W. Webb. *Phys. Rev.* 50. *pp.* 440–445, *Sept.* 1, 1936.—The lifetimes of the potassium doublets λ4047–4 and λ3447–6 were measured by the a.c. excitation method previously described. A sodium-hydride vacuum photo-cell of special design was used to measure the radiation from a potassium cell containing a hot kathode and two anodes. Measurements were made throughout a range of vapour pressures from 4×10^{-5} mm. to 10^{-2} mm. The lifetime of λ4047–4 was found to be $3{\cdot}79 \times 10^{-7}$ sec., the lifetime of λ3447–6 to be $8{\cdot}50 \times 10^{-7}$ sec., with an estimated precision of 1 %. It was shown that the radiation emitted after electron excitation followed a simple exponential law. No change in the measured value of the lifetime was found for either of the doublets throughout the whole pressure range studied. This could be accounted for by the assumption that only 10 % of the absorbed λ4047–4 is re-emitted at the same wave-length, and similarly for λ3447–6. Measurements made of the variation of the emission with pressure, and of the absorption, were consistent with this assumption. AUTHORS.

4701. Absorption Spectrum of Trivalent Cerium Salt. Ta-You Wu and An-Tsai Kiang. *Chinese J. of Physics,* 2. *pp.* 10–14, *April,* 1936. *In English.*—With a view to locating the lowest state of trebly ionised cerium, the absorption spectra of $CeCl_3$ and $Ce_2(SO_4)_3$ solutions are examined between 2,000 Å and 10,000 Å. While no absorption is found in the long wave-length side up to 9500 Å, a new broad absorption region is observed, with centre at about 2105 Å. It is suggested that this and the four other similar absorptions observed by Freed are not related with the transitions $4f^2F_{5/2} - 5d^2D_{3/2,\ 5/2}$, which probably lie in a region not yet covered in this study. AUTHORS.

4702. Deep Terms in the Spectra of Pb V and Bi VI. G. K. Schoepfle. *Phys. Rev.* 50. *pp.* 538–542, *Sept.* 15, 1936.—In earlier investigations the Pt I-like isoelectronic sequence was extended to Pb V and Bi VI, establishing terms due to the $5d^96s$, $5d^96p$, and, later, $5d^97s$ and $5d^{10}$ configurations. This paper extends further the previous results by Mack and by the author to include terms assigned as arising from $5d^98s$, $5d^99s$, $5d^97p$ and $5d^98p$ configurations. A total of 69 term values involving 205 lines are listed for Pb V, and 40 terms involving 94 lines for Bi VI. The wave-length measurements for the lines involved are those made by Arvidsson and range from 1400 to 200 Å, and in more than half the cases the discrepancies are not more than ± 1 cm^{-1}. The absolute values of the $5d^9{}_{5/2}6p_{3/2}$ $J = 3$ terms are computed by a Ritz formula. [See also Abstract 1137 (1935).] AUTHOR.

4703. Optical Properties of Mercury-Vapour Lamps. W. Fabrikant, O. Safrai and M. Aronovitsch. *Techn. Phys., U.S.S.R.* 3. 5. *pp.* 433–440, 1936. *In German.*—Using a stroboscopic method it is shown that the intensity of the lines 5770 and 5790 Å varies through a much wider range during an a.c. cycle than does the intensity of the visible triplet as shown by the lines 5461 and 4358 Å. The light distribution curve of the former lines also has a wider shape than that for the visible triplet, this result agreeing well with the results of absorption measurements. The method used also shows a new phenomenon, that of the variation of the shape of the light distribution curves during a cycle, the variation of the curve for the line 5461 Å being greater than for the lines 5770 and 5790 Å. R. C. F.

4704. Far Ultra-Violet Spectral Intensities and Estimation of Temperature and Pressure in the Vacuum Spark. H. A. Robinson. *Zeits. f. Physik,* 101. 9–10. *pp.* 658–660, 1936.—It is pointed out that the vacuum spark data provide values for the effective temperatures [see Abstract 3202 (1936)] which show a satisfactory agreement with astronomical observations of the O VI spectrum of Wolf-Rayet stars. J. E. K.

4705. Hyperfine Structure Separations in Thallium II Spectrum. S. Smith and J. Convey. *Canad. J. of Research,* 14. *pp. Sect. A.* 139–151, *July,* 1936.—The hyperfine structure separations of about 25 terms of Tl II have been measured by means of two quartz and two glass Lummer plates used in conjunction with a Hilger E1 spectrograph. The light source was a hollow-kathode discharge in He. Large isotope displacements have been found in some of the terms of the $5d^96s^26p$ configuration, also in the $6p^2\,{}^3P_2$ and $6p^2\,{}^1D_2$ terms. The results have been used to calculate $g(I)$ and to examine the validity of the application of the summation rules to the separation factors for the *6snd* and *6snf* configurations. The spacing of the system of levels arising from the *6s6f* configuration has been examined. AUTHORS.

4706. Hyperfine Structure and Isotopes. H. Kopfermann. *Naturwiss.* 24. *pp.* 561–567, *Sept.* 4, 1936.—Short account on the experimental methods of hyperfine-structure investigations and the conclusions that can be drawn from them. R. P.

4707. Nuclear Spin Splitting of Cobalt Terms. E. Rasmussen. *Zeits. f. Physik,* 102. 3–4. *pp.* 229–242, 1936.—The splitting factors were determined for 22 terms from the hyperfine structure analysis of 25 lines in the Co I-spectrum, which contained the ground term and the majority of those belonging to the sextet system. An improved experimental arrangement is described in detail [see also Abstract 1200 (1936)] which deals with similar work on V. Deviations from the interval rule were found in the case of the $3d^7\,4s^2\,{}^4F_{3/2}$-term. It was established beyond doubt that the mechanical moment of the nuclear spin for cobalt amounts to $I = 7/2$. Comprehensive diagrams are included. H. H. Ho.

4708. Magnetic Moment of the Li^7 Nucleus. J. H. Bartlett, Jr., J. J. Gibbons, Jr., and R. E. Watson. *Phys. Rev.* 50. *pp.* 315–319, *Aug.* 15, 1936.—Calculation of the magnetic moment of the Li^7 nucleus, using the experimental data of Fox and Rabi and a wave function due to James and Coolidge [see Abstract 2729 (1936)], results in the value 3·33 nuclear magnetons. AUTHORS.

4709. Gyromagnetic Properties of the Hydrogens. J. M. B. Kellogg, I. I. Rabi and J. R. Zacharias. *Phys. Rev.* 50. *pp.* 472–481, *Sept.* 1, 1936.—The magnitudes of the nuclear moments of the proton and the deuteron are remeasured by the method of atomic beams. The new experimental arrangement is such that the evaluation of the results does not require any information with regard to the velocity distribution of the atoms in the beam. Detection is made objective by the use of a Stern-Pirani detector. The signs of the magnetic moments of the proton and deuteron are determined by the method of nonadiabatic transitions in a weak magnetic field. The results of the experiment are: $\mu_p = 2{\cdot}85 \pm 0{\cdot}15$; $\mu_D = 0{\cdot}85 \pm 0{\cdot}03$ nuclear magnetons. Both moments are positive in sign. AUTHORS.

4710. Intensity Variations of Mercury Molecular Spectra and Origin of Bands at 2482 Å. T. C. Chow and K. T. Chao. *Chinese J. of Physics,* 2. *pp.* 22–37, *April,* 1936. *In English.*—Evidence is given that the system of bands around 2482 Å observed in a mercury lamp is due to the mercury molecular ion. Quantitative determination of the intensity variations of the 2482 bands and other bands of neutral molecules as a function of pressure and current shows marked differences between them. All the differences can only be explained on the basis of an ionic origin of the 2482 bands. The excited state of the molecular ion that emits 2482 bands appears to result from a combination of a normal atomic ion and a neutral atom at the ${}^3P_1$ excited state. AUTHORS.

4711. Spreading in First Positive Bands of Nitrogen. E. T. S. Appleyard. *Phys. Soc., Proc.* 48. *pp.* 763–771, *Sept.* 1, 1936.—The paper describes an experiment designed to distinguish between two theories of secondary excitation of the first positive bands in nitrogen. The resonance radiation of nitrogen emitted from an electron beam is allowed to pass through a thin celluloid window which holds back metastable atoms. The results show that part, and possibly the whole, of the secondary excitation of the first positive bands is due to collisions of the second kind with molecules in the $a^1\Pi$ state. AUTHOR.

4712. Near Infra-Red Absorption Spectra of Aniline Derivatives. Marie Freymann, R. Freymann and P. Rumpf. *Comptes Rendus,* 203. *pp.* 309–311, *July* 27, 1936.—Nine aniline derivatives have been examined between 0·8 and 1·2 μ as pure substances and as $N/2$ solutions in CCl_4. Two bands corresponding with the symmetric and antisymmetric vibrations of NH_2 appear in all spectra separated by a constant frequency difference of 300 cm^{-1}. The influences of solvent, temperature and substituent group on the value of the NH frequencies are discussed. W. R. A.

4713. Near Infra-Red Absorption Spectra of Hydrocarbons and their Halogen Derivatives. E. Trabert and K. Schaum. *Zeits. f. wiss. Phot.* 35. *pp.* 153–170, *July,* 1936.—Results for about 40 compounds between 0·8 and 2·2 μ are tabulated and discussed. W. R. A.

4714. Near Infra-Red Absorption Spectra of Four Aldehydes. L. Kellner. *Roy. Soc., Proc.* 157*A*. *pp.* 100–113, *Oct.* 1, 1936.—An investigation is made of the infra-red absorption spectra of propionic, butyric, valeric, and *iso*-valeric aldehydes in the liquid state between 1·1 and 2·1 μ. The wave-numbers and absorption coefficients are tabulated and compared with previous observations. An attempt is made to interpret the observed bands as overtones and combination tones of the inner vibrations of the CH_3 and CH_2 groups respectively and the $C = O$ valence vibration. It is suggested that four fundamentals are sufficient to explain all observed bands. It is not possible to find a relation between the intensity of the bands and the number of oscillating centres, as most of the vibrational levels lie so close together that resonance occurs. AUTHOR.

4715. Spectrum of Tetramethylethylene and the Influence of the Double Bond. J. Errera, P. Mollet and Mary L. Sherrill. *Comptes Rendus,* 203. *p.* 66, *July* 6, 1936.—A continuation of previous work [see Abstract 4195 (1936)]. The spectrum of tetramethylethylene contains fewer absorption bands than those of other ethylenic compounds and the assignments of bands previously found are confirmed. W. R. A.

4716. Pressure Effect in the HCN Bands in the Near Infra-Red. S. D. Cornell and W. W. Watson. *Phys. Rev.* 50. *pp.* 279–281, *Aug.* 15, 1936.—Contrary to the observations of Herzberg and Spinks [see Abstract 312 (1935)] it is found that all the lines of the HCN absorption band at 1·04 μ are broadened equally by increase in HCN gas pressure. The half-widths increase linearly with pressure at the rate of 0·56 cm.$^{-1}$ per atmosphere. This value is slightly less than that found by H. Becker for the first harmonic band of HCl, as is to be expected from the relative polarisabilities of the two molecules. The results indicate dispersion forces to be the predominant broadening influence. AUTHORS.

4717. Fundamental Absorption Bands of the Deutero-Ammonias. M. V. Migeotte and E. F. Barker. *Phys. Rev.* 50. *pp.* 418–424, *Sept.* 1, 1936.—The four fundamental vibration bands of ND_3 have been measured. The frequencies of the parallel vibrations are $\nu_1 = 2420$, $\nu_3 = 749\cdot 2$ and $745\cdot 8$ cm.$^{-1}$, and of the perpendicular vibrations $\nu_2 = 2556$ and $\nu_4 = 1191\cdot 3$ cm^{-1}. Rotational structure for ν_3 is completely resolved. In the perpendicular bands, zero branches are spaced at intervals of 1·7 cm.$^{-1}$ in ν_2 and 5·2 cm.$^{-1}$ in ν_4, agreeing with the predictions of Johnston and Dennison. The moments of inertia for ND_3 are $C = 8\cdot 985 \times 10^{-40}$ (symmetry axis) and $A = 5\cdot 397 \times 10^{-40}$ (perpendicular axes), giving height of pyramid $= 0\cdot 360 \times 10^{-8}$ cm. and H-H $= 1\cdot 645 \times 10^{-8}$ cm. Observations of doubling of the first excited levels in the four varieties of ammonia and the positions of the higher excited levels in ND_3 give new information on the potential curve. Four vibrational levels, lying above the central potential hump, are observed and correspond to oscillations of the N atom through the plane of the H atoms.

C. B. A.

4718. Rotation-Vibration of Molecules Containing Deuterium. Part II. Spectrum of C_2HD and the C-C and C-H Distances in Acetylene. G. Herzberg, F. Patat and H. Verleger. *Zeits. f. Physik,* 102. 1–2. *pp.* 1–22, 1936.—In order to confirm previous work [see Abstract

310 (1935)] the C_2HD spectrum is again investigated in the photographic infra-red using a considerably greater absorbing depth (16·5 m.) than before. Three new bands are found at 1·063, 0·815 and 0·784 μ and the fine structure measured. The previously reported nuclear distances are confirmed. In the case of the three most intense C_2HD bands subsidiary bands are observed corresponding to transitions in which the lowest vibration ν_5 is excited in the upper and lower states. The vibrational analysis is discussed in the light of considerations of Förster, according to which the transition from C_2H_2 to C_2HD causes the two C-H vibrations to become vibrations which may be practically ascribed to C-H and C-D respectively. Scale diagrams of the modes of valency vibrations of C_2H_2 and C_2HD are given and provisional vibrational constants calculated for C_2HD.
L. A. W.

4719. Lyman Series Absorbed by Oxygen Bands. T. Takamine and T. Suga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 640. *pp.* 213–221, *Aug.*, 1936. *In English.*—While investigating the Lyman series of H_2 in the extreme u.v., it was observed that certain of the lines were considerably weakened. On referring to the recent work of Price and Collins [see Abstract 5024 (1935)] it was ascertained that the phenomenon is due to the presence of a small amount of O_2 having strong absorption bands in the neighbourhood of the Lyman series lines L_3, L_5, L_8 and L_{13}. Hopfield's observation on the selective weakening of L_3 is also cited. AUTHORS.

4720. Absorption Spectrum of Ethyl Methyl Ketone. A. B. F. Duncan, V. R. Ells and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 58. *pp.* 1454–1456, *Aug.*, 1936.—The absorption spectrum of ethyl methyl ketone is investigated at room-temperature from the visible down to about 780 Å. Four (possibly five) different excited electron states in addition to any which may be involved in the short wave continuum must be used to explain the different absorption regions. The bands in the region from 1975 to 1883 Å may be classified as belonging to a single electron transition, using three vibration frequencies in the upper state. A brief discussion, including a general comparison with the acetone bands, is given. AUTHORS.

4721. Far Ultra-Violet Absorption Spectra and Ionisation Potentials of the Alkyl Halides. Part I. W. C. Price. *J. Chem. Phys.* 4. *pp.* 539–551, *Sept.*, 1936.—The absorption spectra of methyl iodide, bromide and chloride have been examined in the region 2,000–1,000 Å. The analysis shows that the bands are due to the excitation of non-bonding electrons localised on the halogen atoms. They can be fitted into Rydberg series which go to the two components of the doublet state of the molecular ion as limits. The values of the ionisation potentials so determined are 9·49 and 10·11 V for methyl iodide, 10·49 and 10·80 V for methyl bromide, and 11·17 and 11·25 V for methyl chloride. The separation of the two ionisation potentials is in excellent agreement with those predicted by R. S. Mulliken, though their actual values are somewhat lower. The electronic and vibrational nature of the bands is discussed and some correlation of the spectra of the three molecules is made. AUTHOR.

4722. Temperature Dependence of the C_2H_5I Absorption Spectrum in the Quartz Ultra-Violet. A. Henrici and G. Milazzo. *Zeits. f. phys. Chem.* 33. *Abt.B.* 3. *pp.* 201–228, 1936.—The pressure and temperature dependence of the absorption spectrum of C_2H_5I is investigated in the quartz ultra-violet up to 1950 Å. The spectrum is divisible into two kinds of groups belonging to two different electron transitions. The first kind of group comprises a sequence of small sharp individual bands at distances of 17 cm.$^{-1}$ and the basic transition probabilities of the strongest bands show a strong temperature dependence. Corresponding to the case of CH_3I these are ascribed to an upper state B. The transition probability in the B-term is the same as in the B-state so that both O-O bands appear at the same pressure. The second kind of group appears as groups of four and leads from the ground state to the B term. The two shortest wave-length individual bands of the groups of four also show a decrease of transition probability at higher temperature. The four-fold character of the groups is interpreted partly as a three-fold electron term separation of the upper state and partly as a group absorption spectrum. Most groups exhibit a characteristic background continuum which increases strongly with increasing temperature. The relationship of the bands to the fundamental vibrations 261,500,740 and 1202 cm.$^{-1}$ is exhibited. J. E. K.

4723. Displacement of Absorption Bands of Dyestuffs by Salt Formation. F. R. Storck. *Helv. Phys. Acta*, 9. 6. *pp.* 437–466, 1936. *In German.*—The absorption spectra of a number of *p*-dimethylaminobenzalketones and of their salts, and of free auramine base and its hydrochloride are recorded. Measurements of ionic concentrations and a colorimetric study of the change of colour on salt formation are also made. Salt formation in the benzalketones is accompanied by displacement of the absorption bands towards shorter wave-lengths, in auramine towards longer wave-lengths. In the former case the salt is formed at a peripheral auxochrome group: in the latter at a central group. Differences in these effects as observed in aqueous or in alcoholic solutions are attributable to interaction between alcohol and acid in this case. Ionic concentrations are too small for the colours to be attributed to them. C. B. A.

4724. $^1\Sigma^*$—$^1\Sigma$ Band System of Copper Deuteride. M. A. Jeppesen. *Phys. Rev.* 50. *pp.* 445–449, *Sept.* 1, 1936.—The copper deuteride bands have been photographed with high dispersion and an analysis is given of the $^1\Sigma^*$—$^1\Sigma$ system. The Cu^{63}D and Cu^{65}D isotopic bands are separated and an independent analysis is given for each. From data obtained for the normal $^1\Sigma$ state, ρ for Cu^{65}D to Cu^{63}D is 0·999503 which agrees with the best mass spectrographic data. A comparison with Heimer and Heimer's CuH analysis gives a value of ρ equal to 0·7131 for Cu^{63}D to Cu^{63}H. The electronic isotope displacement of CuD relative to CuH is 19 cm^{-1}. AUTHOR.

4725. Pressure Effect on the C Band of Strontium Hydride. R. F. Humphreys and W. R. Fredrickson. *Phys. Rev.* 50. *pp.* 542–545, *Sept.* 15, 1936.—At low hydrogen pressures the emission spectrum of the 3808 Å band of SrH shows a sharp break-off at R(18), while at high pressures the lines extend to R(49). The presence of lines with high K values allows an accurate determination of the constants of the upper state. Analysis shows the presence of an uncoupling term $-0{\cdot}1415$ $(K-1)$ in the upper state. Perturbations due to resonance and predissociation are present. The electronic configurations and probable dissociation energies are considered. AUTHORS.

4726. Spectra of SeO and SeO_2. R. K. Asundi, M. Jan-Khan, and R. Samuel. *Roy. Soc., Proc.* 157*A*. *pp.* 28–49, *Oct.* 1, 1936.—The emission spectrum of SeO and the absorption spectrum of SeO_2 are analysed. The energy of excitation and the energy of the $Se = O$ bond are almost identical in SeO and SeO_2, and the vibrational frequencies of SeO have almost the same values as the frequencies of the symmetric valence vibration of SeO_2, both in the normal and the excited state. The same is true about the corresponding anharmonic constants of the two unexcited molecules; that of excited SeO could not be measured. The results indicate strong localisation of the two Se = O bonds in SeO_2. The analysis of the band system of SeO_2 is in complete agreement with Herzberg and Teller's theoretical selection rule for $\Delta v_{(antisym)}$ for polyatomic molecules. AUTHORS.

4727. Predissociation and Auto-Ionisation in the Term Sequences of the Hydrogen (H_2) Spectrum. H. Beutler and H. O. Jünger. *Zeits. f. Physik*, 101. 5–6. *pp.* 285–303, 1936.—All known electron terms of H_2 are investigated with reference to the way in which the predissociation and auto-ionisation limits are exceeded in their vibration and rotation term sequences. A new predissociation point is found in the $3s^3\Sigma$ term at $v' = 3$, $K' = 1$. The disappearance of the K^1_e term for $K'' > 1$ in $3p\ {}^3\Pi c$ ($v'' = 7, 8, 9$) and the breaking off of the system $4d^3\Delta_a$ at $v^1 = 3$, $K^1 = 4$ is interpreted as auto-ionisation. Conditions do not favour the discovery of a breaking-off point with certainty in the singlet system. From the breaking off points in the triplet system the distance between the two decomposition limits is found to be $\Delta\nu = 6048 \pm 15$ cm^{-1}. From the absorption spectrum it is found in the singlet system that $\Delta\nu = 6053 \pm 12$ cm^{-1}. In consequence of this agreement the two isolated partial groups of the triplet electron terms can be fitted on to the ionisation limit (124429 ± 13 cm^{-1}.) of the singlet system. The positions of the triplet terms should thus be lowered by 125 to 139 cm^{-1} with reference to the ground state of H_2. J. E. K.

4728. Absorption Coefficient of H^-. C. K. Jen. *Chinese J. of Physics*, 2. *pp.* 38–42, *April*, 1936. *In English.*—A simple calculation has been carried out for the absorption coefficient of H^-. The matrix component of transition is calculated from the combination of a free-electron wave function obtained by averaging the Hylleraas wave function for H^- over the coordinates of one electron. The absorption coefficient covering a wide range of optical spectrum is in the order of 10^{-17} cm^2. [See Abstract 2437 (1933).] AUTHOR.

4729. Band Spectra and Valency. R. Samuel. *Current Science*, 4. *pp.* 762–767, *April*, and *pp.* 830–832, *May*, 1936.—Full report of an address dealing with: (i) electronic configurations in diatomic molecules, promoted and non-promoted electrons, and dissociation of diatomic molecules; (ii) development of the method of molecular orbitals by the introduction of new postulates to form a theory of valency; (iii) the electron-pair bond and the single-electron bond theories of valency, and the two wave-mechanical methods of treatment, namely the Heitler-London-Slater-Pauling method and the orbital method; (iv) arguments for the pair-bond theory. W. J.

4730. Strengths of Binding in the H_2 Molecule. H. Beutler and H. O. Jünger. *Zeits. f. Physik*, 101. 5–6. *pp.* 304–310, 1936.—The energy values for the dissociation and ionisation of H_2 are obtained from spectroscopic observations and the theory of band spectra on the one hand and from purely theoretical calculations on the other hand. Within the given limits of error there is found to be complete agreement between the values obtained by the different methods. J. E. K.

4731. Absorption and Energy Bands of Alkali Halide Crystals. A. Smekal. *Zeits. f. Physik*, 101. 11–12. *pp.* 661–679, 1936.—It is deduced from the theory of electron binding in crystal lattices that the permitted energy bands are influenced by crystal surfaces and are unsymmetrically broadened by the presence of inhomogeneous elastic states of deformation of the lattice. Both of these phenomena are proved by experimental data for alkali halide crystals. The absorption bands of alkali halide crystals which are investigated in detail are shown to result from electron transitions from sharp surface energy levels to the next higher energy bands of the crystal lattice. The symmetrical absorption bands result from electron transitions in the unstrained lattice region and are characterised by approximately equal zero point–half width values. The unsymmetrical absorption bands are limited to parts of the crystal in which foreign atoms produce elastic internal stresses. J. E. K.

4732. Spectroscopy of Ion Crystals and Alkali Halides. A. v. Hippel. *Zeits. f. Physik*, 101. 11–12. *pp.* 680–720, 1936.—The principal differences between electron transitions in the gaseous state and in the ion crystal are first discussed quite generally and then used as a basis for a systematic investigation of the spectroscopic behaviour of the alkali halides. Considerable success is achieved in explaining the very complicated relations by relatively simple considerations which seem likely to find extensive application beyond the confines of this particular investigation. The scope of the discussion can be judged from the following sub-titles :—Electron transitions in ion crystals ; the first maximum of the u.v. characteristic absorption of alkali halide crystals ; the band structure of the u.v. characteristic absorption ; external photo-effect and inner potential ; the absorption spectrum in the far u.v. ; the electron exchange bands (colour bands) ; the phosphorescence mechanism ; excitation and coloration ; "additive" coloration ; the "U"-bands ; the phosphorescence in "U"-band crystals ; notes on silver halides. J. E. K.

4733. Form, Force Constants and Vibration Frequencies of Triatomic Systems. W. G. Penney and G. B. B. M. Sutherland. *Roy. Soc., Proc.* 156*A*. *pp.* 654–678, *Sept.* 1, 1936.—The equations of the valence and central force fields offer possibilities for determining the form and the force constants of symmetrical triatomic molecules of the type BA_2. A critical investigation is made in this paper of the reliability of these equations. It is shown that those of the valence force field are generally to be preferred to those of the central force field, as they are usually more nearly self-consistent and give better results in various test cases. From a comparison of the force constants of the valence force field throughout sets of molecules of similar electronic structure certain well-marked regularities appear. These afford valuable checks on the assignments of the fundamental vibration frequencies in molecules where they are doubtful. It appears that present assignments in O_3, NO_2^-, F_2O, and Cl_2O are open to severe criticism, and new assignments conforming much better to the general scheme are suggested in O_3, F_2O, and Cl_2O. Badger's relation is tested by calculating the internuclear distances from the force constants and comparing the results with values known from other evidence. AUTHORS.

4734. Fundamental Vibration Frequencies in O_3, F_2O, Cl_2O, NO_2, and N_3^-. G. B. B. M. Sutherland and W. G. Penney. *Roy. Soc., Proc.* 156*A*. *pp.* 678–686, *Sept.* 1, 1936.—The interpretations of the vibration spectra of O_3, F_2O, Cl_2O, NO_2, and N_3^-, in terms of the fundamental vibration frequencies are considered. Suspicion that earlier assignments in the first three of these molecules were not correct has arisen because they imply extraordinary rigidity to angle deformation. New assignments not having this disadvantage are accordingly suggested and it is shown that these interpret the experimental data at least as well as, if not better than, the older assignments. A discussion is also given of the interpretation of the vibration spectrum of NO_2 and N_3^-. Difficulties are met with in the former because the contours of two combination bands appear to disagree with an assignment which is otherwise perfectly satisfactory. A reason for this discrepancy is suggested. The azide ion is interesting because it seems to have a slightly different structure in aqueous solution (where it is almost certainly linear and symmetrical) and in the lead azides. Further experimental work on the ion in solution and in crystals of varying " ionicity " are highly desirable. AUTHORS.

4735. Electron Affinity Spectrum of Ferrous Ion in Aqueous Solution. R. H. Potterill, O. J. Walker and J. Weiss. *Roy. Soc., Proc.* **156***A.* ***pp.*** **561–570,** ***Sept.*** **1, 1936.**—The extinction coefficients of solutions of ferrous and ferric sulphates and chlorides have been measured for wave-lengths down to 2200 Å. The Fe^{++} ion in solution has in this region a continuous absorption wtih a long wave-length limit of about 2900 Å. On the irradiation of $FeSO_4$ solutions below 2900 Å, H_2 is evolved, with the simultaneous formation of ferric ion. The quantum efficiency for the formation of H_2 has been measured and found to have a value of about 1/20. The observed photochemical reaction is attributed to a primary process analogous to that of the electron affinity spectrum, *viz.*, $Fe^{++}\ HOH + h\nu \leftarrow Fe^{+++} + H + OH^-$, followed by the combination reaction of the H atoms formed, $H + H \rightarrow H_2$, which competes with the reverse reaction, $Fe^{+++} + H \rightarrow Fe^{++} + H^+$. The experimental observations lead to the conclusion that the energy of activation of the simple electron transfer process in the forward direction is about 7 k.cal.
AUTHORS.

4736. Absorption of Light in Cæsium Vapour in the Presence of Foreign Gases. R. W. Ditchburn and J. Harding. *Roy. Soc., Proc.* **157***A.* ***pp.*** **66–79,** ***Oct.*** **1, 1936.**—The continuous absorption of Cs vapour in the presence of several foreign gases has been measured. All gases cause a reduction in the amount of absorption. The pressures required to reduce the absorption to half-value vary from 32 mm. for helium to 0·9 mm. for benzene. For the rare gases the half-value pressures decrease with increasing atomic weight. The absorption curve near the series-limit is changed in shape, the slope of the curve becoming smaller and the maximum absorption being shifted to shorter wave-lengths. No complete theory is available, but certain simple generalisations are given.
AUTHORS.

4737. Stark Effect of Alkali Metal Atoms. Ta-You Wu. *Chinese J. of Physics,* **2.** ***pp.*** **15–21,** ***April,*** **1936.** *In English.*—The general feature of the Stark effect of the alkali atoms, the linear effect observed by Ny and Choong for the lines near the series limit of Cs and Rb, the decomposition of the m^2S-n^2D lines of Na into n-2 equidistant components, and the appearance of m^2S-n^2S series in σ polarisation are discussed on the basis of the perturbation theory. AUTHOR.

4738. Stark Effect in Hydrogen. G. Gurewitsch. *Phys. Zeits. d. Sowjetunion,* **9. 6.** ***pp.*** **563–579, 1936.** *In German.*—An approximate solution is given of the Schrödinger equation for the Stark effect. A system of equations for the energy levels is set up which constitutes a generalisation of that already set up by Lanczos for the case of $m = 0$. The term displacements calculated by this method are compared with the experimental values, and with those deduced from the perturbation theory. A. C. M.

4739. Raman Effect and Dipole Moment in Relation to Free Rotation. Part V. Intramolecular Potential of Ethane Derivatives. S. Mizushima and Y. Morino. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 638. *pp.* 188–206, *July,* 1936. *In English.*—Raman spectra of ethylene chlorobromide and hexachlorethane have been examined. These and previously obtained spectra on di- and tetra-halides of ethane are used to discuss the intramolecular potential of ethane derivatives. [For Part IV see Abstract 4234 (1936).] W. R. A.

4740. Raman Spectra of Boron Compounds. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 74–81, *July,* 1936.—The Raman spectra of methyl and ethyl borates are investigated, and it is found that the Raman frequencies previously reported for these substances require considerable revision. The Raman spectrum of methyl borate in the region of low frequencies shows great similarity to the spectra of PCl_3 and $AsCl_3$, and this similarity is strikingly brought out by the polarisation characters of the Raman lines. A pyramidal structure is postulated for the $B(OCH_3)_3$ molecule, the group (OCH_3) being treated as a single unit. The observed and calculated frequencies are in fair agreement. The Raman spectrum of boron tri-bromide is reported for the first time, and consists of two very intense lines and three very weak ones. These are compared with the frequencies of the tri-chloride. Only one line was found in the case of boric acid, which si attributed to the totally symmetrical vibration of the molecule. AUTHOR.

4741. Raman Spectra of Cyclo-Propane and Ethylene Oxide. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 82–90, *July,* 1936.—The Raman spectrum of cyclo-propane is investigated at room-temperature both in liquid and vapour states. Ten frequencies are recorded in the spectrum of the liquid of which four are reported for the first time. The state of polarisation of the vibrational Raman lines is also studied. The four intense Raman lines of the liquid (863, 1187, 3008 and 3028) are also recorded in the spectrum of the vapour. The significance of the presence of the frequency $\Delta\nu = 863$ in the spectrum of the vapour is pointed out. The relative intensity of the Raman lines 3008 and 3028 is considerably modified in passing from the liquid to the vapour state. The Raman spectrum of ethylene oxide also shows ten frequencies of which two have not been previously recorded. The spectrum shows great similarity to that of cyclo-propane. The polarisation characters of the Raman lines are determined, and the molecular configuration discussed. AUTHOR.

4742. Raman Spectrum and Constitution of Water. M. Magat. *Ann. de Physique,* 6. *pp.* 109–193, *July–Aug.,* 1936.—A long and critical discussion is given of the Raman spectrum of water, and of the influence upon the Raman spectrum of temperature and addition of electrolytes. A discussion of the infra-red spectrum of water permits the identification of three fundamental frequencies of a molecule with reference to its neighbours. A fourth frequency (3630 cm.$^{-1}$) appearing above 40° C. seems to be due to molecules possessing a free rotation in the liquid. The remaining frequencies (60, 200, 500, 700, 2135 and 4023) are due to intermolecular vibrations, or to the combination of these with intramolecular vibrations. In the second part of the paper a model is proposed for the water molecule, from which is calculated the heat of evaporation of water, and the energy necessary for a molecule to be able to turn freely in the field of its neighbours. Only the rotation around the symmetry-axis is possible at normal temperatures; the appearance of this rotation above 40° C. is probably connected with the disappearance of discrete libration-vibration bands.

A. C. M.

4743. Effect of Dissolved Substances upon the Raman Spectrum of Dioxane. A. Simon and F. Fehér. *Zeits. f. Elektrochem.* 42. *pp.* 688–691, *Sept.*, 1936.—Raman spectra are photographed for mixtures of dioxane with H_2O, H_2O_2, CCl_4, CH_3CN, CH_3NH_2, HCN, NH_3, HCl, PCl_3 and $AsCl_3$. Of the 17 lines of dioxane, 3 are found to be displaced by polar substances. The magnitude of the effect is not governed by the magnitude of the dipole moment, but by the shape of the molecule concerned and the location of the moment. The results indicate that the effects are due probably to electrostatic interaction and not to the formation of definite molecular compounds. It is noted that the CO-frequencies are lowered while neighbouring CH-frequencies are raised—an observation which is of interest in connection with the allocation of frequencies in complex spectra. The Raman frequencies of the constituents of binary mixtures are mutually affected.

L. A. W.

4744. Raman Spectra of Substances Having Five-Membered Ring Structure. A. W. Reitz. *Zeits. f. phys. Chem.* 33. *Abt.B.* 3. *pp.* 179–195, 1936.—Raman spectra are reported for cyclopentane, cyclopentene, cyclopentadiene, thiophene, furane, pyrrol. A preliminary discussion is given of the symmetry-properties of five-membered rings, but the whole matter is reserved for later discussion, after model- and polarisation-experiments have been completed.

A. C. M.

***4745. Polarisation Measurements upon Raman Lines. Part I. Experimental Method. A. W. Reitz.** *Zeits. f. phys. Chem.* 33. *Abt.B.* 5. *pp.* 368–386, 1936.—An account is given of the requirements to be satisfied by an experimental arrangement for adequate polarisation measurements upon Raman lines. The various sources of error (convergence, apparatus polarisation, grain of plate, use of photometer, etc.) and the means for avoiding or minimising them are discussed. An actual apparatus is then described in the construction of which the foregoing considerations are taken into account. The scattering volume is only 4 c.c. and with filtered primary light exposure times ranging from 12 to 48 hr. are required. For sufficiently exposed, non-polarised lines the error in the determination of the depolarisation factor is found to be 4 to 5 %.

L. A. W.

4746. Polarisation of Raman Lines of Formic Acid, and Formate and Trichloracetate Ions. J. Gupta. *Indian Journ. Phys.* 10. *pp.* 313-318, *July*, 1936.—The degrees of depolarisation of the prominent Raman lines of formic acid and of sodium formate and sodium trichloracetate in aqueous solutions are measured, using a double-image prism to record the two components simultaneously and determining the relative intensities of the components with the help of blackening-log (intensity) curves. It is found that the degree of depolarisation of the line 1398 cm^{-1}. of formic acid is 0·41, which is much greater than that of either the line 1353 cm^{-1}. of sodium formate or the line 1330 cm^{-1}. of sodium trichloracetate. This fact indicates positively that the origin of the line 1353 cm^{-1}. of sodium is different from that of the line 1398 cm^{-1}. of formic acid. The agreement between the values of ρ of the line 1353 cm^{-1}. of sodium formate solution and of the line 1330 cm^{-1}. of sodium trichloracetate solution goes to show that the two lines owe their origin to the same mode of vibration of the carboxyl group. AUTHOR.

4747. Analysis of Organic Substances by Raman Effect. W. Hanle and F. Heidenreich. *Phys. Zeits.* 37. *pp.* 594–595, *Aug.* 15, 1936.—Using a spectrograph of aperture 1 : 5 and exposures from ½ to 5 hr. it is possible to detect admixtures of 1 to 2 % of some organic substances by their Raman lines. In the least favourable cases, 10 % can be easily detected. It was found that in benzene with an admixture of 2 % dioxane, the Raman lines of dioxane are easily observable. Their intensity, as compared to the benzene lines, seems to fall off less than proportionally with the concentration. R. P.

***4748. Photometric Calibration of Spectrograms by Utilising Polarisation in Spectrographs. Y. Öhman.** *Astron. Iakttagelser och Undersökning, Stockholms, Obs.* 12. 6. [14 *pp.*], 1936. *In German.*—By including a doubly refracting crystal in a spectrograph two spectra are produced adjacent to one another and polarised perpendicularly to one another. The crystal is oriented so that double refraction occurs in the direction of the slit. The extraordinary spectrum appears weaker in intensity than the ordinary spectrum as a result of the polarisation due to the passage of light through the prism. For any particular instrument the intensity ratio of the two images is always the same and when once determined can be used for photometric calibration. This method has many advantages over other calibration methods and practical examples are given of its application to intensity measurement with the spectrograph of Stockholm Observatory. J. E. K.

***4749. Hydrogen Lamp with Quasi-Punctiform Illumination Region. F. Almasy and G. Kortüm.** *Zeits. f. Elektrochem.* 42. *p.* 607, *Aug.*, 1936.—The continuous spectrum H_2-discharge lamp which is generally suitable for the photography of u.v. absorption band spectra suffers from the defect that the discharge is not sufficiently localised in position to permit accurate determination of absolute extinction coefficients. A new type of H_2 lamp is described in which this defect is overcome by introducing a specially shaped porcelain body into the discharge region the effect of which is to produce a localised region of illumination when viewed from one end of the tube whilst the original extended illumination remains visible from the other end of the tube. J. E. K.

4750. Photographic Spectrophotometry of Solutions. H. v. Halban, G. Kortüm and B. Szigeti. *Zeits. f. Elektrochem.* 42. *pp.* 628–631, *Aug.*, 1936.—An image of a H_2-lamp, in which the illumination is practically limited to a point, is formed on the slit of a spectrograph, over which are placed two closely neighbouring windows. The absorbing solution is placed in the beam, with one window open, and the photographic plate exposed for a fixed time ; then the solvent is substituted, and with the other window open the plate is exposed again for the same time. The output of the H_2-lamp is maintained constant by means of a barretter lamp. In this way a pair of closely neighbouring spectra are photographed. The condensing lens is fitted with a calibrated variable diaphragm, and a series of pairs of spectra are photographed with different degrees of opening of the diaphragm. Points of equal blackening in each pair of spectra are found by means of a microphotometer. Results of tests are given, and an accuracy of 1 % is claimed. D. H. F.

4751. Quantitative Spectrum Analysis of Al, Zn and Mn in "Elektron" Alloy. L. Wwedjenski and S. Mandelstam. *Techn. Phys., U.S.S.R.* 3. 7. *pp.* 662–681, 1936. *In German.*—Two methods are described for the estimation of these metals in the concentration ranges 4–8 %, 0·5—1·5 %, and 0·15—0·5 % respectively. Both are based on Gerlach's method of "homologous pairs." In one, the intensities of pairs of visible lines are compared, using a polarisation photometer; the average error of a number of determinations ranges from 6 to 8 % for the different metals. In the other method, pairs of u.v. lines are used and the intensities are compared photographically, by means of visual interpolation on a scale provided by photographing the spectrum with a calibrated "stepped wedge" over the slit of the spectrograph. The errors here are a little greater than those in the other method. D. H. F.

See also Abstracts 4457, 4648, 4654, 4668, 4794, 4908, 4909.

VISION.

4752. Vision in Optical Instruments. C. Fabry. *Phys. Soc., Proc.* 48. *pp.* 747–762, *Sept.* 1, 1936.—Discusses the importance of the properties of the eye in considering what it is possible to see in an optical instrument, and points out that there is an enormous disparity between these properties and the predictions of diffraction theory. The effect of this in using perfect and imperfect instruments is considered. A. H.

X-RAYS.

4753. Cloud-Chamber Study of the Compton Effect. H. R. Crane, E. R. Gaerttner and J. J. Turin. *Phys. Rev.* 50. *pp.* 302–308, *Aug.* 15, 1936.—An experiment is described which is designed to test the photon theory of scattering in the energy region between 0·5 and 2·6 eMV. A small pencil of radiation from a thorium source is shot through a cloud chamber. A celluloid scatterer 0·8 mm. thick is plaed in the beam at the centre of the chamber. Two thin lead sheets are placed parallel to, and on each side of, the primary beam, to absorb the scattered photons. A magnetic field is applied to determine the energies of the electrons. From the energy and direction of an electron ejected from the scatterer, the direction of the scattered photon expected from theory can be calculated, and is independent of any assumption about the energy of the primary photon. Out of 10,000 photographs taken, 300 electron-photon combinations were found. The angular and energy relations of these seem to indicate that the photon theory of scattering is valid. It is shown experimentally that the scattering of the electrons in the celluloid is of the right order of magnitude to account, at least in part, for the observed deviations of the results from theory. [See also Abstract 4685 (1936).] AUTHORS.

4754. Form and Width of Compton Lines. H. Kappeler. *Ann. d. Physik.* 27. 2. *pp.* 129–168, *Sept.*, 1936.—A very detailed descriptive and theoretical discussion of the Compton effect leads up to a statement of the characteristics of the shift due to the scattering of monochromatic X-rays at different angles from a scattering body. The total wave-length change is shown to be composed of three parts, a true Compton effect, a change analogous to the Doppler effect due to the velocity of the electrons within the atom, and, finally, a shift due to the amount of binding of the electrons in the atom. A triple-filter process devised by Wollan, is used in the experimental section to determine the intensity distribution in the Compton lines from which the velocity distribution of the electrons in the atom can be found. The filters used were composed of Sr, Yt, and Zr whose absorption edges lie very close to the wave-lengths used; *i.e.*, the $K\alpha_1$ and $K\alpha_2$ lines of Mo. Careful construction, balancing and correction of the filters is necessary and is described fully. Results for Ne, O_2, N_2, C, Li, and NaF are given graphically and in tables. For Ne a comparison is made with two theoretical curves, calculated by two different processes. The agreement is very good. Half-value widths of the lines are given in each case. The most probable velocity of the electrons in the Ne atom is determined as $4\cdot0 \times 10^8$ cm. per sec., while the theoretical value is $3\cdot85 \times 10^8$ cm. per sec. G. O. B.

4755. Anisotropy in the Atomic Vibrations of Zinc Crystals. Parts I and II. G. E. M. Jauncey and W. A. Bruce. *Phys. Rev.* 50. *pp.* 408–416, *Sept.* 1, 1936.—The results of Brindley's recent experiments on the intensity of the various reflections of Cu Kα X-rays from powdered Zn crystals are compared with the results of the measurements made by the authors on the diffuse scattering of X-rays from single Zn crystals. When the method of diffuse scattering is used it is possible to obtain S values for various orientations of the crystal for a given value of $(\sin \frac{1}{2}\phi)/\lambda$. The form of Zener's formula for *M* for hexagonal crystals is confirmed by our experimental results. We find the root mean square thermal displacements of the atoms to be 0·172 and 0·093 Å respectively, along and perpendicular to the *c* axis. These are greater than Brindley's values. They nearly explain the large difference between the F values for the (0002) and $(10\bar{1}0)$ reflections. These two reflections possibly give some evidence of asymmetry in the electron structure of the Zn atoms, the structure being more diffuse in the direction of the *c* axis than normal to this direction. The general radiation from a tungsten tube was used together with the Jauncey and Claus method of integration over all wave-lengths. Because of the high absorption coefficient of zinc it was necessary to scatter the X-rays from the front surface of the Zn crystals. Correction for the presence of fluorescent rays was made. A number of Zn crystals were grown. The control of the direction of the major and minor axes with respect to the surface of the crystal is described. Two types of experiment were made: (1) the variation of S with ψ, the orientation angle, for a fixed value of ϕ, the scattering angle; and (2) the variation of S with ϕ for two fixed values of ψ, one near 90° and the other near 0°. (1) gave remarkable confirmation of the correctness of the form of Zener's formula for the Debye-Waller *M* for hexagonal crystals, while (2) confirmed in a general way our values as obtained in (1) for *a* and *b* in Zener's formula. We find a much higher anisotropy, $a - b = 1\cdot66$, than that suggested by Brindley, $a - b = 0\cdot785$. [See following Abstract.] AUTHORS.

4756. Anisotropy in the Atomic Vibrations of Zinc Crystals. Part III. R. D. Miller and E. S. Foster, Jr. *Phys. Rev.* 50. *pp.* 417–418, *Sept.* 1, 1936.—The ratio of the F value for the (0002) reflection to the F value for the $(10\bar{1}0)$ reflection of Mo Kα X-rays from powdered zinc was found to be 0·891. This compares very well with Brindley's value of 0·894. Our results suggest that the value of F for the $(10\bar{1}1)$ reflection of Cu Kα rays is 20·1, which is somewhat higher than Brindley's value. [See preceding Abstract.] AUTHORS.

4757. Mass Absorption Coefficients of Se, Ag, Cd, Te, Au, Pb and Bi for Monochromatic X-Rays. K. Schulz. *Ann. d. Physik,* 27. 1. *pp.* 1–14, *Sept.,* 1936.—A method of determining X-ray mass absorption coefficients, by using thin films of the substance under test, is extended to the study of Se, Ag, Cd, Te, Au, Pb and Bi, between the wavelength limits $\lambda_{\alpha\alpha'} = 0 \cdot 1623$ to $2 \cdot 2863$. A technique is described whereby metallic films of very much less thickness than formerly can be prepared. The method depends on the evaporation of the metal *in vacuo* on to a thin supporting film of celluloid, cellophane or aluminium. Films of from 1 to 60μ thickness were prepared by this method. A process is given which makes it possible to determine the mass per unit area of very thin foils, in which the X-ray absorption can be compared with that in a thick sheet. Filters were used to obtain a pure monochromatic $K_{\alpha\alpha'}$ ray. The results for μ/ρ are given in tabular form, and also are plotted logarithmically. The agreement with previous results is quite good. Values for C and n in the equation $\mu/\rho = C\lambda^n$ are obtained for Se, Ag, Cd, and Te, at the K-edge, and for Au, Pb, and Bi, at the L-edge. For the K-absorption jump in Se and Te, and for the L-jumps in Au, Pb and Bi, values are given which, in the latter case, agree well with the results of other investigators. G. O. B.

4758. Photographic Blackening and X-Ray Exposure. Part II. J. E. de Langhe. *Zeits. f. wiss. Phot.* 35. *pp.* 171–174, *July,* 1936.—Extends the previously developed theoretical considerations [see Abstract 3540 (1935)] taking into account the effect of the spectral composition of the X-rays, and the influence of the emulsion fog. R. C. F.

4759. Photographic Inversion with Monochromatic and Heterogeneous X-Rays. K. Prosad, S. Basu and B. N. Ghosh. *Zeits. f. Physik,* 102. 3–4. *pp.* 259–271, 1936.—The radiation of Cu, Fe and Pt antikathodes was photographed either directly, or after monochromatisation in a Bragg spectrometer with a calcite or rock-salt crystal, on Ilford " Golden Isozenith " plates. The blackening was measured for different exposures and was found to show no maximum or only one if monochromatic radiation was used. The unfiltered radiation, on the other hand, showed a number of maxima and minima for exposures of several hours. This difference may either be due to the different spectral composition or to the different intensity. The result is discussed in connection with different theories of the photographic action. R. P.

4760. Photographic Action of X-Rays. G. E. Bell. *Brit. J. of Radiology,* 9. *pp.* 578–605, *Sept.,* 1936.—It is shown that the photographic action of X-rays is similar to that of light, and that exposures can conveniently be expressed in röntgens. The H. and D. curves of various emulsions were found to have long toes, and the density only became proportional to log exposure at densities of 3. The curves are well represented by the Busé equation $B = C \log (AQ + 1)$. The shapes of the curves are unaffected by variations in the quality and the intensity of the incident radiation, and the sensitivity of the emulsion to radiations of different qualities may be related to the H.V.L. of the radiation. At low densities, and for most common developers, the photographic density is nearly proportional to the exposure for densities less than unity. The Bunsen-Roscoe reciprocity law was found to hold over an intensity ratio of 100 : 1, and was confirmed with less accuracy over the range of 10,000 : 1. No intermittency effect was detected when 50-cycle pulsating voltages were used. G. E. B.

4761. Effects of Chemical Combination on the K-Emission Lines of Ni, Co, V and Ti. G. Okuno. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 306–318, *July,* 1936. *In English.*—The effects of chemical combination on the $K\alpha_1$, α_2, β_1 and β' lines of the elements Ni, Co, V and Ti were studied with them and their compounds NiO, Ni_2O_3, CoO, $CoCO_3$, $CoSO_4$, V_2O_5, NH_4VO_3, TiO_2 and K_2TiF_6. $K\beta'$ appeared, in all the cases, as a diffuse band, not separated from $K\beta_1$. The effects of chemical combination on the wave-lengths of the lines were not clearly detected in the cases of Ni and Co, and some effects were found in the cases of V and Ti.

AUTHOR.

4762. Lα-Emission Spectra of Erbium, Ytterbium, and Lutecium. Yvette Cauchois. *Comptes Rendus,* 203. *pp.* 398–399, *Aug.* 10, 1936.—Satellite lines in the emission spectra of Er(68), Yb(70), and Lu(71) are described and tabulated. Two lines are measured in each case, two of the three found for (73) to (92) being no longer separable; the lines were formerly supposed to disappear between (50) and (75).

T. L. M.

4763. L-Emission Spectrum of Radium. H. Hulubei. *Comptes Rendus,* 203. *pp.* 399–400, *Aug.* 10, 1936.—The L spectrum is almost unknown between (83) and (90); the author has studied (87) and (88) and tabulates 21 lines of the latter, measured against numerous comparison lines; only one of the Ra-lines has been given previously.

T. L. M.

4764. Widths of L-Absorption Edges. A. E. Sandström. *Phil. Mag.* 22. *pp.* 497–513, *Sept.,* 1936.—Widths of some L-edges are measured on photographically recorded spectra. The full width of an absorption edge is defined as the distance (in X.U., frequency units, or volts) between points of maximum and minimum intensity. The width of the " idealised " edge is also defined. The influence of the thickness of the absorbing screen, the properties of the photographic plate, etc., are discussed. It is found that it is possible to measure the full width of an edge in photographic spectra, but not the width of an " idealised " edge. The full widths of most of the L_{II} and L_{III} edges and some L_I edges are measured for elements 30 Zn to 52 Te. C. J. B. C.

See also Abstracts 4443, 4444, 4472, 4685, 4686.

HEAT.

CALORIMETRY.

***4765. Specific Heat of Gases at High Temperatures by the Sound Velocity Method. Part II. Carbon Dioxide. G. G. Sherratt and E. Griffiths.** *Roy. Soc., Proc.* 156*A. pp.* 504–517, *Sept.* 1, 1936.—Specific heat values up to 1000° C. are found, using a modified form of the apparatus previously described [see Abstract 5105 (1934)]. Frequencies of 8, 14, and 19 kc./s. are used, and no appreciable dispersion is found over this range, although a greater increase in sound absorption with frequency was observed than would be expected from classical theory. The absorption at 27 kc. was so considerable that the measurements became impossible. The observed increase is accounted for by the theory which ascribes the effect to the time lag in the transfer of energy between the vibrational and the other energy states of a molecule. The increase above the classical value, observed at 19 kc., is shown by this theory to be consistent with the absence of any increase in velocity at that frequency. N. M. B.

4766. Simple and Exact Method for Heat Loss Determination. H. Moser. *Phys. Zeits.* 37. *pp.* 529–533, *Aug.* 1, 1936.—The paper describes a method for the determination of heat losses from the total heat measurements obtained with a bomb calorimeter. S. G. B.

See also Abstracts 4475, 4776.

CONDUCTION.

4767. Thermal Conductivity of Electrets. G. Groetzinger. *Phys. Zeits.* 37. *pp.* 589–592, *Aug.* 15, 1936.—In the present publication [see also Abstract 2619 (1935)] it is shown experimentally that the electret exhibits a greater thermal conductivity than the unpolarised substance. This alteration in thermal conduction is therefore a criterion for electrets and remains in existence when the electret produces no electrical field. The conductivity experiments were carried out by Schleiermacher's method and full details are included. The results appear to support the hypothesis that in a solid body whose molecules possess a permanent electrical moment, there is a state in which the moment takes up a definite direction without the action of a permanent external field. H. H. Ho.

4768. Temperature Distribution in the Gas Surrounding a Metal Sphere. R. S. Silver. *Phil. Mag.* 22. *pp.* 466–480, *Sept.*, 1936.—Previous attempts at solution are first described and then a good approximation is sought which would serve the special circumstances. The problem is changed to a uniform medium problem simply by regarding the sphere as an apparatus for maintaining a spherical surface at constant temperature for a short but finite time, and then superposing the known effects of certain sources in a uniform medium. The expression arrived at when t (the time) $\neq 0$, is

$$\theta_{r=a} = \frac{T_0}{2} + \frac{T_0}{\sqrt{\pi}} \int_{a/\sqrt{\kappa}}^{\infty} e^{-x^2} dx,$$

where T_0 is the initial temperature of the surface; tables are included showing the distribution given by θ at various times for values of a (the radius) respectively 0·25 cm. and 0·1 cm., and these give an idea of the limit of time up to which this solution may be applied to the metal sphere and gas problem. The above solution, however, carries a rise in temperature at $r = a$ when the initial period of constancy is past, and an alternative expression is derived :

$$\theta_{r=a} = \frac{T_0}{2} + \frac{T_0}{\sqrt{\pi}}\int_{a/\sqrt{\kappa t}}^{\infty} e^{-x^2}dx - \frac{2T_0}{\sqrt{\pi}}\int_{r/2\sqrt{\kappa t}}^{\infty} e^{-x^2}dx.$$

The significance of each solution with its limitations is discussed.

H. H. Ho.

4769. Influence of Magnetic Fields on the Heat Conductivity of Gases. Parts II and III. H. Senftleben and J. Pietzner. *Ann. d. Physik*, 27. 2. *pp*. 108–122, *Sept.*, 1936.—In Part I of this paper [see Abstract 3670 (1933)], the effect of a magnetic field on the heat conductivity of a paramagnetic gas was discussed, and it was expressed by means of an empirical formula. Part II deals with the relation between the direction of the magnetic field and the direction of the heat flow. Apparatus suitable for the production of the necessary magnetic fields and heat transfers is described. It is shown that a maximum effect occurs when the field and the heat flow are perpendicular, the effect falling off symmetrically for angles above and below 90°. Further, the difference between the " parallel " and " perpendicular " effects is constant for all field strengths above a certain value, which is greater, the greater the pressure, for pressures from 30–760 mms. Hg. A theoretical investigation, due to Laue, is introduced, and it is shown that for oxygen there is good agreement between the theoretical and experimental curves of the variation of the effect with the angle between the two vectors. In Part III the variation of the effect with pressure, at low pressures, is investigated. It is shown that the effect diminishes with pressure, and finally disappears when the pressure is such that the mean free path of the gas molecules is comparable with the dimensions of the apparatus. E. H. D.

4770. Effects of Hydrogen on the Thermal Conductivity of Cotton Wool. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 18. *pp*. 280–286, *June*, 1936. *In English.*—Two specimens of cotton wool containing different percentages of air and H_2 form two parallel plates, the one is heated on the upper side by a steam heater and the other cooled on the lower side by ice. The temperature of the surface between the two specimens is found by a copper-constantan couple inserted between the two plates. When a steady flow of heat is established, the conductivities are in inverse ratios to the temperature gradients. The lower cotton wool pad, which is the standard, contains air and the other is slowly filled with the mixture of air and H_2 from a bell-jar. Values of the ratio $K_{t(gas)}/K_t$(air) are plotted against the percentage of H_2 and give nearly a straight line. From known values of the conductivity of air in cotton wool, that of H_2 is calculated. H. M. B.

***4771. Measurement of the Thermal Resistivities of Insulating Materials. H. Batsch and A. Meissner.** *Zeits. f. techn. Physik*, 17. 8. *pp*. 283–285, 1936.—Apparatus for the rapid measurement of the thermal resistivities of insulating materials is described. The test specimen in the form of a thin plate is sandwiched between a water-cooled Al base-plate and an iron disc containing an electric heating unit. An electromagnet situated under the base-plate attracts the iron disc, and ensures that the surfaces are held together with a force equivalent to about 8 kg. Thermal contact between the insulator and the metal surfaces is further improved by means of oil-films. Heat losses are minimised by coating the exposed iron surface with polished Al-foil, and evacuating the enclosure to a pressure of less than 2×10^{-2} mm. of Hg. The energy input is measured and a small correction applied to allow for the radiation loss. Thermocouples in the upper and lower plates enable the temperature drop across the insulator to be determined. Steady conditions are established in about 20 min. in the case of porcelain, but about 90 min. are required for a much poorer conductor of hard rubber. An accuracy of 5 % is claimed. R. W. P.

***4772. Determination of Thermal Conductivity of Metals. H. Krainer.** *Zeits. f. techn. Physik*, 17. 8. *pp.* 281–282, 1936.—A cylindrical ring is used the inner side of which is heated electrically and the temperature gradient measured radially. In spite of the relatively simple means employed the results are quite accurate. Full experimental details are given, with results for steels of different composition. S. G. B.

See also Abstract 4449.

CONVECTION.

4773. Theoretical Dimensions of Bénard Cellular Vortices. P. Vernotte. *Comptes Rendus*, 203. *pp.* 43–46, *July* 6, 1936.—A continuation and partial correction of a previous paper [see Abstract 3735 (1936)]. S. G.

DILATATION.

4774. Thermal Expansion of Magnesium Oxide. M. A. Durand. *Physics*, 7. *pp.* 297–298, *Aug.*, 1936.—The thermal expansion of single crystal MgO is measured from 85° K to 480° K. The results are combined with those of Austin, so that data are available from 85° K to 1273° K. The observed thermal expansion of this substance is in excellent accord with the relation, due to Grüneisen, between thermal expansion and heat content. AUTHOR.

MELTING AND BOILING POINTS.

4775. Atomic Dimensions and Melting Points. D. H. Brauns. *Bureau of Standards, J. of Research*, 17. *pp.* 837–845, *Sept.*, 1936.—In comparing the melting points of the noble gases, halogens, and elements of the sulphur group the author found that those elements of these groups which have analogous differences in atomic structure show an apparent relationship between their melting points and their atomic dimensions, the differences in the melting points being proportional to the differences between the corresponding atomic radii. Further, it was found that for these elements with analogous differences in atomic structure an apparent proportionality exists between the differences in the atomic radii and the differences in the sublimation points at low pressure. AUTHOR.

4776. Thermal Effects due to Order-Disorder Transformations. C. Sykes and F. W. Jones. *Inst. of Metals, J.* 59. [24 *pp.*], 1936. *Advance Copy.*—This paper describes an experimental method particularly suitable for the determination of thermal changes in order-disorder transformations occurring in the temperature range 100°–500° C. [See also Abstract 388 (1936).] AUTHORS.

4777. Ebulliometric and Tonometric Measurements on Normal Aliphatic Hydrocarbons. M. Wojciechowski. *Bureau of Standards, J. of Research*, 17. *pp.* 953–958, *Sept.*, 1936—By the application of the precise method developed by W. Swietoslawski for measuring the boiling points and the differences between boiling point of liquids and the condensation temperature of their vapours, it is possible to determine several facts of interest to the chemist. Among these are the purity of the substance under investigation, its boiling point, and the relation of boiling point to pressure. The normal hydrocarbons, pentane, hexane, heptane, and octane have been studied by this method. The ebulliometric control of purity of the preparations, the use of substances of high purity, and the application of a method of comparative measurements ensure the accuracy of the results reported. The numerical data are as follows: *n*-pentane, boiling point 36·077, $dt/dp = 0\cdot0391$; *n*-hexane, 68·733, and 0·0420; *n*-heptane, 98·365, and 0·0449; *n*-octane, 125·658 and 0·0477. It was found that the introduction of a CH_2 group into the chain of each of the normal aliphatic hydrocarbons investigated has the specific effect of increasing the dt/dp ratio by the amount 0·0029. AUTHOR.

4778. Boiling Point of Ethyl Ether and its Relation to Pressure. M. Wojciechowski. *Bureau of Standards, J. of Research*, 17. *pp*. 959–961, *Sept*., 1936.—Ethyl ether of a high degree of purity was prepared, and its boiling point was found to be 34·481 ± 0·003° C. The dt/dp ratio of ethyl ether (degrees per mm. at 760 mm. of Hg) is 0·0372. AUTHOR.

4779. Azeotropic Mixture of Acetylene and Ethane at Atmospheric Pressure. W. A. McMillan. *Am. Chem. Soc., J.* 58. *p*. 1345, *Aug*., 1936.—The existence and composition of an azeotropic mixture of acetylene and ethane at atmospheric pressure have been determined. AUTHOR.

See also Abstracts 4529, 4839.

TEMPERATURE, MEASUREMENT OF.

4780. Kelvin Temperature of the Ice Point. J. R. Roebuck. *Phys. Rev.* 50. *pp*. 370–375, *Aug*. 15, 1936.—The data of the author and his colleagues on the Joule-Thomson effect are used to calculate the value of the ice point on the Kelvin thermodynamic scale from the data on the coefficients of volume and pressure expansion found in the literature. The gases involved are air, helium, argon and nitrogen. The results are, air 273·158, helium 273·168, nitrogen 273·125 and the most probable value 273·16 ± 0·02. These are compared with accepted values. The use of a helium mixture to give the ice point precisely as the reciprocal of the coefficient of volume expansion is suggested. AUTHOR.

***4781. Comparison of Platinum Resistance Thermometers with the Helium Gas Thermometer in the Range 14° K. to 90° K. F. Henning and J. Otto.** *Phys. Zeits.* 37. *pp*. 601–609, *Sept*. 1, 1936. *From the Reichsanstalt*.—The purpose of the investigation is to derive a means for the calibration of Pt resistance thermometers over the temperature range 14° to 90° K. without recourse to a gas thermometer. Experiments are described in which a Pt thermometer is compared with a He thermometer over this range. It is shown that the resistance of the Pt wire can be correlated with the temperature by means of an expression containing five constants. R. W. P.

***4782. Photo-Thermometry. K. Hencky and P. Neubert.** *A.T.M. No.* 62. *T*100–*T*101, *Aug*., 1936.—Most methods of measuring surface temperatures involve some disturbance of the temperature distribution. Methods using the electromagnetic waves emitted by the hot body have not this drawback, but hitherto photographic records were

impossible because of the strong absorption of the infra-red by the glass of the lens. Many such difficulties have now been overcome, and this paper describes apparatus and materials suitable for the measurement of surface temperatures over the range 350°–750° C. Using special lenses and filters a suitable darkening of a photographic plate is produced, and the temperature is deduced from the ratio of the transparency of the body of the plate to that of the exposed portion. Curves and tables are given showing the relation between this ratio and the temperature; and the exposures necessary to record various temperatures. Full details are given of the apparatus necessary for calibration, and this includes a short discussion of the emission coefficient of the cobalt oxide elements used.
E. H. D.

***4783. Precision Thermostat for Temperature Regulation of a Room. T. Deighton.** *Journ. Sci. Instruments,* 13. *pp.* 298–300, *Sept.,* 1936.—A thermostat capable of regulating the temperature of a small room with a variation of only ± 0·01° C. has been constructed. The principles involved are (*a*) great turbulence of the room air and (*b*) the provision of two connected expansion chambers, one controlled by the room temperature and the other, a subsidiary one, controlled by the heating apparatus itself, serving to take up the lag at once, whenever the relay is operated. The apparatus is simple, cheap and efficient and has been in use for 18 months. AUTHOR.

4784. Dependence on Temperature of the Characteristics Used in Temperature Measurements. W. Jacyna. *Zeits. f. Physik,* 101. 11–12. *pp.* 785–786, 1936.—A short addendum to a previous paper [see Abstract 3746 (1936)]. J. J. S.

See also Abstracts 4611, 4668.

THERMOCHEMISTRY.

4785. Heats of Solution of Salts in Heavy Water. E. Lange and W. Martin. *Zeits. f. Elektrochem.* 42. *pp.* 662–668, *Sept.,* 1936.—Three kinds of isotopic effects are first considered with respect to ionic solvation, *viz.,* isotopic ions in the same solvent, the same ions in isotopic solvents and isotopic ions in isotopic solvents. Experimental work on heats of solution is then described for H_2O and D_2O as solvents, wherein the isotopic effects for 16 alkali halides have been measured. The ΔL-values obtained are relatively great and amount roughly to 1 % of the heat of solvation of the ion itself. The results indicate an addition rule to be followed, whereby the effects for anions and kations may be dealt with independently of each other, and from which the ΔL-values for salts may be evaluated. Differences between anions and kations are discussed. A new calorimetric field of investigation is indicated by the authors who give full experimental details of their work. H. H. Ho.

4786. Intermolecular Forces of the Isomers of 2,3-Dibrombutane. H. G. Trieschmann. *Zeits. f. phys. Chem.* 33. *Abt.B.*4. *pp.* 283–289, 1936.—The values of and differences between the intermolecular forces of the isomers of 2,3-dibrombutane are recorded and discussed in connection with previous measurements, particularly those obtained by K. L. Wolf and co-workers. [See Abstract 2295 (1936).] J. K.

4787. Atomic Heats of Formation and Bond Energies. F. G. Soper. *Chem. Soc., J. pp.* 1126–1130, *Aug.,* 1936.—The CH_2-increment in calculated heats of formation in the paraffin and saturated aliphatic alcohol series is not quite constant along the series. This has been ascribed by Pauling to variations in the polarity (of the additional C-C and C-H bonds) caused by the induced effects of neighbouring groups. The author examines the magnitude of these effects, calculating the changes in coulombic energy in terms of known dipole moments and interatomic distances for the bonds concerned, and shows this correction to remove the major part of the variations. The corrected bond energies for C-C and C-H are 73·4 and 91·3 kg.-cals. respectively; these values are applied to deduce the value for C-Cl in the chloro-paraffin series. L. V. C.

4788. Combustion in Electric Field. A. E. Malinowski and K. E. Jegorow. *Acta Physicochimica*, 4. 6. *pp*. 929–936, 1936. *In German.*—A method is devised permitting the application of the flame-manometer to the process of combustion, thus allowing the estimation of the very small pressure changes which occur in the combustion of gaseous mixtures. The prevention of combustion, *i.e.*, of the active zones by the electric field, longitudinally applied with reference to the gas stream, is explained by the mechanical effects of the field. The behaviour of inner core on the application of different electric field appears to the authors to be chiefly ascribable to the negative ions. The influence of the concentration of mixtures on the separation of the inner core from the outer is investigated. The applied field has an effect only on high concentration of C_2H_2 (25 to 22 %) and methane mixtures show only a very small effect. As an electric field has no effect on a H_2 flame, a small effect on a CH_4 flame, and a strong effect on a C_2H_2 flame, it is deduced that the action of an electric field is the stronger the greater the amount of C in the molecule of the combustible material. J. K.

4789. Combustion Engine Temperatures by the Sodium Line-Reversal Method. M. J. Brevoort. *Rev. Sci. Instruments*, 7. *pp*. 342–346, *Sept.*, 1936.—The sodium line-reversal method has been used in some preliminary measurements of flame temperature. Improvements in the method involving a photographic recorder and a means of correcting for the dirtiness of the windows are described. The temperatures so obtained are compared with those calculated from pressure diagrams. AUTHOR.

4790. Flame Velocity by Modified Burner Method. F. A. Smith and S. F. Pickering. *Bureau of Standards, J. of Research*, 17. *pp*. 7–43, *July*, 1936.—The velocity of propagation of flame is determined relative to mixtures with air of various combustible gases. The effects of varying the size of the burner port, of changing the velocity of flow of the mixture from the burner, of changing the composition of the mixture, and of different methods of measuring the flame and computing the result are given. The most consistent results are obtained when the shape of the flame surface most nearly approximates a geometrical cone. It is concluded that while the burner method has a number of limitations it is nevertheless as simple and useful as any of the methods available at present. J. K.

4791. Induction Period of Cold Flames in Pentane-Oxygen Mixtures. B. Aivazov and M. Neumann. *Zeits. f. phys. Chem.* 33. *Abt.B.* 5. *pp*. 349–367, 1936.—Investigations are carried out upon the dependence of the induction period of cold flames in pentane-O_2 mixtures upon the temperature, pressure, size of vessel, composition of mixture and admixture of N_2. An empirical formula for the induction period involving these variables is put forward. It is also found that addition of acetaldehyde or of very small concentrations of NO_2 causes a decrease in the induction period and a lowering of the minimum pressure at which the formation of cold flames is possible. In the discussion of the results a chain mechanism is proposed and on the basis of this an interpretation of the empirical formula is obtained. L. A. W.

4792. Special Solutions for the Motion of Powder Gas. R. H. Kent. *Physics*, 7. *pp*. 319–324, *Sept*., 1936.—An important error in Love and Pidduck's special solution [see Abstract 1483 (1922)] is pointed out. Special solutions for a perfect and an imperfect gas are obtained. Modifications to take account of projectile friction and the burning of the powder are given. AUTHOR.

4793. Latent Energy in Explosions. W. T. David and A. S. Leah. *Phil. Mag*. 22. *pp*. 513–523, *Sept*., 1936.—Large vessel explosion experiments are described in which the long-lived latent energy left in the exploded gas varies between 1·1 % of the heat combustion and 8·5 % to 9·1 %. The smaller value is obtained in over-rich CO-O_2 mixtures at 3 atmospheres initial pressure, and the larger values in argon diluted CO mixture at ½ atmosphere and in pentane-air mixture at ½ atmosphere. It is concluded that the smaller value would be decreased still further in explosions at higher initial pressures, and the higher values increased at lower initial pressures. The amount of latent energy obtaining in exploded gaseous mixtures also varies with the nature of the combustible gas and the nature of the diluent gas. These results are in agreement with deductions in regard to latent energy in constant pressure combustion. C. J. B. C.

4794. Spectrographic Method for the Study of the Thermal Decomposition of Ozone. É. Vassy. *Comptes Rendus*, 203. *pp*. 403–406, *Aug*. 10, 1936.—The coefficient of absorption of O_3 varies with temperature [see Abstract 3118 (1936)]. By repeatedly warming O_3 to 115° C. and cooling to 20° C. in equal times the absorption coefficient at 115° C. is obtained. This is used to measure the rate of decomposition of O_3 at 115° C. The result is less than that of Glissman and Schumacher at 110°. The results agree with the theory for a second order reaction up to times of observation of 10 hr. After this adsorbed gas is liberated from the walls. This is proved by washing the tube with O_2 and watching the appearance of the O_3 spectroscopically. H. G. C.

4795. Reaction Rates of Non-isothermal Processes. J. Sherman. *Indust. and Engin. Chem*. 28. *pp*. 1026–1031, *Sept*., 1936.—Reactions which proceed non-isothermally are discussed for various time-temperature relations. The pertinent integrals are evaluated for calculating the amount of reaction when the time-temperature change is linear, exponential, sinusoidal, and polynomial. Examples are given of the application of the results to specific problems. AUTHOR.

4796. Ionic Radii and Heat of Hydration. A. Voet. *Faraday Soc., Trans*. 32. *pp*. 1301–1304, *Sept*., 1936.—A linear relationship is established between ionic radii and reciprocal heats of hydration of positive ions. An explanation is proposed on the basis of the electrostatic theory. A modification of the Born-Bjerrum equation is introduced and its validity discussed. AUTHOR.

See also Abstracts 4469, 4766, 4776, 4851.

THERMODYNAMICS.

4797. Thermal and Caloric Equation of Rate of Condensed Hydrogen Isotopes. G. Bartholomé. *Zeits. f. phys. Chem*. 33. *Abt.B*. 5. *pp*. 387–404, 1936.—This paper continues previous work [see

Abstract 5112 (1935)] and records measurements of the volume isotherms for H_2 and D_2 at three temperatures in the liquid region. It was found that the earlier derived expression $(L/\Delta v)_{H_2} = (L/\Delta v)_{D_2}$, was invalid, and that only the heats of fusion were equal. The triple points of the expansion coefficients of solid H_2 and D_2 were found from thermodynamic calculation to be 0·12 and 0·08 respectively, while the corresponding compressibilities were 0·014 and 0·006. From these data, the molecular volume at absolute zero for H_2 is 22·9 cm. and for D_2 20·3 cm. *i.e.* a difference of 11 % at 0° K. Measurements of the specific heat C_v of the solid products enable the Debye Θ value to be fixed for H_2 at 105° and for D_2 at 97°. The deviation is explained as due to the influence of anharmonicity. Measurements of C_v for the liquid phase were carried out for the control of the compressibility data, and for the detailed description of the thermal state diagram. H. H. Ho.

4798. Thermodynamic Properties of Methane. W. C. Edmister. *Indust. & Engin. Chem.* 28. *pp.* 1112–1116, *Sept.*, 1936.—Specific heats at constant pressure, differences in specific heats, Joule-Thomson coefficients, entropy, and enthalpy are computed for methane for pressures of 1 to 120 atmospheres and for temperatures of −70° to 200° C. This work is based on the P-V-T data of Kvalnes and Gaddy and of Keyes and Burks, and on the specific heat at constant-pressure data at 1 atmosphere of Eucken and Lüde. Data on these thermodynamic properties are presented, and from them the specific volume, internal energy, Gibbs free energy, and Helmholtz free energy may be calculated also. Plots of the volume residual, α versus T isobars, C_p versus T isobars, C_p-C_v versus T isobars, and the Joule-Thomson coefficient, μ versus T isobars are also presented. AUTHOR.

4799. Mechanism of Division of Metabolising Systems. J. M. Reiner. *Physics*, 7. *pp.* 368–374, *Sept.*, 1936.—In an extension of the work of N. Rashevsky [see Abstract 386 (1935)] the problem is treated of the determination of the distribution of concentrations and consequent distribution of osmotic forces in a metabolising liquid sphere subject to a general infinitesimal deformation. The principle of virtual displacements in the form of an inequality is applied as a criterion of the instability (tendency to divide) of the system. This gives an algebraic equation determining the critical radius at which the system becomes unstable, and the equation is analysed in detail with reference to the influence of the physical parameters of the system. In particular, it is found that, for a certain range of size of the system, this critical value is practically independent of the surface tension. Finally, the diffusion equations are integrated for a system where the rate of reaction is not constant, but a linear function of the concentration, and a procedure similar to the above is outlined. AUTHOR.

See also Abstracts 4498, 4552, 4556, 4795.

VAPOUR PRESSURE.

4800. Raoult Depression in Ordinary and Heavy Water. V. T. Chiplunker. *Indian Journ. Phys.* 10. *pp.* 275–276, *July*, 1936.—McKay's theory for the deficiency of heavy water in the Dead Sea is criticised and a possible explanation suggested on thermodynamical grounds for an impedance in the escape of heavy water, relative to ordinary, in the presence of a solute. AUTHOR.

See also Abstracts 4529, 4552, 4654.

ACOUSTICS.

4801. Duration of Contact of a Pianoforte String with a Hard Hammer Striking Near the End. S. C. Dhar. *Indian Journ. Phys.* 10. *pp.* 305–311, *July,* 1936.—A critical study is made of the existing theories of the vibration of the pianoforte string when struck by a hard hammer near the end. The values of the duration of contact are calculated from the theoretical formulæ of Kaufmann and of Kar-Ghosh as well as by the direct graphical method which, although involving enormous labour in evaluating λ, is more accurate than that of Kar-Ghosh. Taking into account the probable error of observation in determining experimentally the value of the duration of contact of such a small order of magnitude, the agreement between the calculated values and the available experimental data may be considered to be sufficiently close. In view of this close agreement, it is apparent that the idea of the series, as originally introduced by Raman and Banerjee to explain the theory of the struck string, should be abandoned. AUTHOR.

4802. Dispersion of Acoustic Velocity in Organic Liquids. S. Parthasarathy. *Indian Acad. Sci., Proc.* 4.*A. pp.* 17–22, *July,* 1936.—Acoustic velocities at about 7×10^6 c./s. and 20×10^6 c./s. are determined in some hydrocarbons, one alcohol, ketones, esters, ethers, halogen substituted compounds and a base. No dispersion in velocity can be detected in any of these compounds. AUTHOR.

4803. Ultrasonic Velocities in Organic Liquids. S. Parthasarathy. *Indian Acad. Sci., Proc.* 4*A. pp.* 59–63, *July,* 1936.—The paper gives ultrasonic velocities and adiabatic compressibilities in the following compounds: methyl cyclohexanols (*o, m, p*), methyl cyclohexanones (*o, p*), tertiary amyl alcohol (sec.), octyl alcohol, mesitylene, diphenyl methane, dekahydronaphthalene, *p*-cymene, β-picoline, acetonitrile and phenyl mustard oil. The relation between sound veolcities and chemical constitution is discussed. [See Abstract 4295 (1936).] AUTHOR.

4804. Visibility of Ultrasonic Waves. P. R. Pisharoty. *Indian Acad. Sci., Proc.* 4*A. pp.* 27–36, *July,* 1936.—The diffraction effects caused by a simple-harmonically corrugated wave-front when propagated through distances small compared with the extent of the wave-front—small enough as not to allow the various orders of spectra to separate out, are considered. Such a wave-front on propagation develops at a definite distance $d = \frac{1}{4}(\lambda^*)^2/\lambda$, where λ^* is the wave-length of the phase variation and λ is the wave-length in the medium, into one of uniform phase but having periodic *amplitude* changes on it. On further propagation to twice this distance it becomes a corrugated wave-front again. At intermediate stages there are both amplitude and phase changes. At a distance $\frac{3}{4}(\lambda^*)^2/\lambda$ the pattern is similar to that at d but is displaced laterally through $\lambda^*/2$. It is suggested that the visibility of the progressive ultrasonic waves observed with a microscope and a Kerr cell is due to these amplitude changes brought about by the propagation of a purely corrugated wave-front. Lord Rayleigh's theory of the "Foucault's test" is applied to such a wave-front and it is shown that its Schlieren effects would be poor. AUTHOR.

***4805. Sound Diffraction Spectrum as Light Relay. O. Maercks.** *Phys. Zeits.* 37. *pp.* 562–565, *Aug.* 1, 1936.—Experiments are described in which the diffraction of light by sound waves is employed to produce intermittent light. Light rays pass through a glass trough which contains a vibrating quartz, liquid and reflector. A lens causes the rays to converge on a slit which is adjusted to allow rays of zero order to pass. This light varies in intensity with frequency $2n$ where n is the frequency of the quartz. It falls on a photo-cell in parallel with the circuit of a back-coupled receiver tuned approximately to $2n$ and shielded from the sender which excites the quartz. Heterodyne action gives rise to an audible tone which disappears when the light is cut off or when the slit is widened sufficiently. A method based on the foregoing is described by which the degree of modulation of the light was measured for zero order and for the rest of the orders combined. The possibilities of the method are discussed. G. E. A.

4806. Diffraction of Light by Ultrasonic Waves. S. Rytov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 2. 6. *pp.* 229–233, 1936. *In French.*—The author has worked out approximate formulæ for amplitude and phase which are more exact than those of Raman and Nath, and are more suitable for quantitative calculations than Brillouin's rigorous solution. G. E. A.

4807. Behaviour of Suspended Matter in Vibrating Gases at Sonic and Supersonic Frequencies. O. Brandt. *Kolloid Zeits.* 76. *pp.* 272–278, *Sept.*, 1936.—A brief survey of previous work in this field is first given and then follows the description of measurements concerning the velocity of aggregation when influenced by sonic and supersonic vibrations in static and flowing gases containing paraffin particles (*i.e.*, paraffin fogs). Since such particles are undoubtedly spherical, all uncertainty in measurement is thereby removed. The apparatus used and the experimental details are fully described. Separate sections deal with the period of fall of the particles, rate of change of particle size as obtained by optical measurements, and phenomena in flowing fogs of paraffinated gases. Comprehensive tables of data, diagrams and Bibliography are included. H. H. Ho.

4808. Absorption of Supersonic Radiation in Liquids as Dependent on Temperature. C. Sörensen. *Ann. d. Physik,* 27. 1. *pp.* 70–74, *Sept.*, 1936.—In continuation of previous work [see Abstract 3276 (1936)] the effect of temperature on a the coefficient of absorption of supersonic radiation is measured for a number of liquids at the frequencies 530 and 950 kc. The coefficient is also calculated from the classical theory of Kirchhoff and Stokes. In acetone, alcohol, toluol and xylol, a increases with temperature at both frequencies. In benzol it increases at 530 kc. but is independent of the temperature at the higher frequency. In water a diminishes with rise of temperature but not so much as the theory requires. A new method of measuring supersonic intensity is outlined. G. E. A.

4809. Resonance Absorption of Sound. S. Rschevkin. *Techn. Phys., U.S.S.R.* 3. 6. *pp.* 560–576, 1936. *In English.*—It is shown theoretically that a system of a number of like resonators exerts a double effect on the reverberation of an auditorium in which it exists; on the one hand as if the effective volume were increased at the cost of the stored energy in the resonators, and on the other the loss due to friction, *i.e.*, the absorption of sound is increased. As a result of these two effects reverberation can be lengthened (in the case of slight damping of the resonators) or shortened (in the case of considerable damping). The author realises both cases experimentally. The possibility of increasing the sound absorption by the use of a resonator system has considerable practical significance since it enables the useful efficiency of the absorber to be raised and so the absorption to be increased in any desired frequency range. J. E. B.

***4810. Sound Recorder of the Philips-Miller System. A. T. van Urk.** *Philips Techn. Rev.* 1. *pp.* 135–141, *May*, 1936.—In this article the connection between the resonance frequency and the attainable amplitude is discussed for various constructions. It is shown that the attainable amplitudes are very small in all cases (of the order of 0·1 mm.) and only by a marked magnification of the amplitude by means of the special shape of the cutter can a sound track of normal width (1·8 mm.) be recorded. The magnetic driving system finally evolved and its operating characteristics are discussed in detail. [See also Abstract 4302 (1936).] AUTHOR.

***4811. Testing of a Condenser Microphone. V. Thorsen.** *Zeits. f. Physik*, 101. 9–10. *pp.* 578–592, 1936.—A description is given of the testing of a condenser microphone in such a way that the microphone is brought into a field of stationary waves and the disturbance so caused is determined by means of a Rayleigh disc. On the hypothesis that the microphone is a radiator of zero order it is possible to calculate the sound pressure at the microphone if there is employed as radiator model a pulsating sphere (with long waves) or a flat membrane (with short waves). J. J. S.

4812. Efficiency of Telephones and Threshold Sensitivity of the Ear. E. Waetzmann and H. Kalusche. *Ann. d. Physik*, 27. 1. *pp.* 15–28, *Sept.*, 1936.—In continuation of the work of Waetzmann and Heisig [see Abstract 3533 (1931)] the electroacoustic efficiency of telephones having resonance frequencies ranging from 80∼ to 4500∼ is deduced from measurements of the damping when associated with an artificial ear having non-absorbent walls and with a number of human ears. The efficiency is measured either with the telephone in contact with the ear or when separated from it by a tube. Values ranging from 1 % to 18 % are obtained when the telephone is in contact with the ear. The results are used to determine the threshold sensitivity of the ear at various frequencies and the ear sensitivities of a number of observers are exhibited graphically. It is found that unreliable results are obtained if the telephone is in direct contact with the ear but that by using a connecting tube, the current to be measured is increased with an increase in accuracy which brings the results into accord with the commonly accepted figures. It is noted that a number of the observers had sensitivities less than normal. J. E. R. C.

4813. Sound Absorption and Velocity in Mixtures of Gases. D. G. Bourgin. *Phys. Rev.* 50. *pp.* 355–369, *Aug.* 15, 1936.—The author has developed a theory of sound absorption in mixtures of gases in which are considered the effects, on sound propagation, of (*a*) collision excitation probabilities dependent on the internal energy specification of the impinging molecules, (*b*) transitions in both colliding members, (*c*) triple and higher order collisions, and (*d*) viscosity and conduction. A comparative study of the generalised Kneser-Ruttgers method and the writer's method of investigation brings out that the two are developments of the same physical theory, and may be regarded as a thermodynamic and a kinetic theory transcript respectively. Formulæ are derived for the velocity and the absorption coefficient in convenient form for application. [See Abstract 1138 (1933).] G. E. A.

See also Abstracts 4505, 4509, 4510, 4920.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***4814. Screening of A.C. Bridges. T. Walcher.** *A.T.M.* No. 62. *T*106–*T*109, *Aug.*, 1936.—The paper summarises the principles of electrostatic screening applied to a.c. bridge networks. The screening of bridge components (resistors, inductors and capacitors) is discussed and arrangements are described for screening two or more components when connected in series or in parallel. Multiple screening of bridges on the lines laid down by G. A. Campbell is discussed and the principles applied to the case of the generalised Wheatstone bridge are extended to cover the case of the Anderson network. An outline is given of the application of a screened bridge to the measurement of the intercapacitance of a twinned cable. The paper concludes with some general remarks on the screening of the auxiliary apparatus (oscillators, amplifiers, detectors, etc.). N. F. A.

See also Abstract 4841.

CONDUCTION AND DISCHARGE IN GASES.

4815. Air-Carbon Arc in High Vacuum. F. H. Newman. *Phil. Mag.* 22. *pp.* 463–465, *Sept.*, 1936.—The present paper describes experiments with the cold-kathode arc between C electrodes at very low gas pressures. The data obtained support the view that thermionic emission cannot be solely responsible for the starting and maintenance of the electric arc ; the fact that it starts instantaneously with the application of the electrical discharge supports the high-field theory. In practice, if, for any reason, the arc does not strike when the high voltage is applied, a continuance of the electrical discharge is seldom effective, even if the electrodes are raised to a high temperature by the ionic bombardment arising from the discharge. It is shown that if a small quantity of a substance to be examined spectroscopically is placed on the end of the positive C electrode and the arc struck, the spectrum of the substance can be seen and photographed at the instant the arc is started. This method is of particular service when volatile metals are to be determined, and since there is little continuous spectrum, it should prove preferable to the more usual method of packing the substance in a hole bored in the positive carbon. H. H. Ho.

4816. Method for Studying Kathode Phenomena in Arc Discharges. L. R. Koller. *Physics*, 7. *pp.* 295–296, *Aug.*, 1936.—A phototube method is devised to study kathode temperatures in hot-kathode arc discharges. It consists in operating the arc on a.c. and observing the photo-current due to the radiation from the kathode during the half-cycle that the arc is out. The assumption is made that the filament does not cool appreciably in this half-cycle. The method is not capable of high accuracy since it can only be used with large arc currents, when the heating effect of the current is considerable and difficult to correct for. Some typical results are given. C. J. B. C.

4817. Propagation of Potential in Discharge Tubes. L. B. Snoddy, J. W. Beams and J. R. Dietrich. *Phys. Rev.* 50. *pp.* 469–471, *Sept.* 1, 1936.—The mechanism of the propagation of luminosity through a discharge tube when an impulsive potential is applied is studied by measuring the rate of propagation of the potential wave along the tube. Dry air at pressures between 0·017 and 0·24 mm. Hg is used in the tube; the potentials applied are from 74 to 171 kV. The measurements are made by means of a kathode ray oscillograph of the Dufour type. The potential wave travels through the tube with a velocity of the order of 10^9 cm. per sec. This velocity increases both with increasing gas pressure and with increasing potential. The potential wave is followed by a return wave of much higher velocity, travelling backwards from the far end of the discharge tube. The attenuation, wave-form and energy in the wave front also vary with pressure and potential. G. G.

4818. Ignition Potentials of Pre-Ionised Glow Discharges. C. Deimel. *Phys. Zeits.* 37. *pp.* 610–623, *Sept.* 1, 1936.—An investigation was made of the way in which the ignition potential, the kathode fall and the complete characteristic of a glow discharge in the gases Ne, He, A and H at pressures in the range of 0·5 to 15 Tor (1 Tor = 1 mm. Hg.), are affected by a second electrode situated behind the meshed kathode. The normal kathode fall of the glow discharge was found to be very much reduced by pre-ionisation. For values of the product *pd* (*p* = pressure, *d* = electrode distance) above that for the ignition potential minimum the ignition potential was lowered very considerably by the action of the auxiliary discharge. Reductions up to 80 % were observed. For *pd* values less than that corresponding to the ignition potential minimum the reductions observed were only small. The effect of very small quantities of foreign gases on the value of the ignition potential and the functional relation between the ignition potential lowering and pre-ionisation was also investigated. It is concluded that the effect on the primary discharge is due to the electrons of the auxiliary discharge. The possible influence of other factors is discussed. In Ne, He and A the lowering of the ignition potential was found to be a linear function of the square root of the current strength of the auxiliary discharge for small pre-ionisation intensities. A. W.

4819. Constitution of the Glow Kathode Discharge Near and Within Hollow Glow Kathodes. E. F. Richter. *Zeits. f. techn. Physik*, 17. 9. *pp.* 306-315, 1936.—Wth the help of about 1200 characteristic lines from Langmuir probes a glow kathode discharge was mapped out in the neighbourhood of, and on the axis of, an indirectly heated hollow kathode. The distributions of potential found correspond with those observed by Compton and Eckart in the l.v. arc with a feather kathode. Distributions of potential, electron temperature, and electron current were measured with variation of the anode current strength, of the heat tension at the kathode, of the gas pressure in the tube, of the geometry of the kathode, and of the kind of gas. The results of the measurements are collected in tables and comparison is made with the investigations of other observers. J. J. S.

4820. Negative Ion Formation. F. L. Arnot and J. C. Milligan. *Roy. Soc., Proc.* 156*A*. *pp.* 538–560, *Sept.* 1, 1936.—Atomic negative Hg ions are shown to be produced in Hg vapour by a new process of formation; they originate from positive ions which pick up two electrons on any negatively charged electrode to which they are driven. The probability of occurrence of this radiationless process is $1\cdot 7 \times 10^{-5} - 6\cdot 4 \times 10^{-4}$ for positive ions of 10 – 180 V impinging on a Ni electrode. Negative ions, if any, produced by the radiative process of electron attachment to free atoms are completely masked by the far greater number formed by the new process. Many of these come off the electrode on which they are produced with high energies, over 20 V for parent positive ion impact of 200 V; this provides a new and more informative method for obtaining accommodation coefficients for positive ions; the mean value for 200-V positive ions reflected as negative ions from a tungsten filament at 2200° Abs. is 0·987, and the minimum value is less than 0·90. This disproves a recent view, based on classical collision theory, that the coefficient should be less than unity only if the mass of the positive ions is less than that of the atoms of the reflecting surface. N. M. B.

4821. Ionisation of Air by Lenard Rays. L. S. Taylor. *Bureau of Standards, J. of Research,* 17. *pp.* 983–990, *Sept.,* 1936.—Lenard rays in air have been measured by means of simple ionisation chambers. At ordinary intensities, encountered with Lenard rays, it is impossible to saturate such ionisation chambers and this has resulted in neglect of the method for practical purposes. It has been found, however, that plotting the reciprocal current against the reciprocal voltage, a straight line results, which can be extrapolated to $1/V = 0$; thereby giving the current at infinite field. Several such cases are given. Unipolar conductivity is evident in at least one ionisation chamber. AUTHOR.

4822. Ionisation, Excitation, and Chemical Reaction in Uniform Electric Fields. Part II. Energy Balance and Energy Efficiencies for the Principal Electron Processes in Hydrogen. R. W. Lunt and C. A. Meek. *Roy. Soc., Proc.* 157*A. pp.* 146–166, *Oct.* 1, 1936.—This paper makes an attempt to calculate the absolute values of the energy efficiencies and fractional energy losses for the principal collision processes effected by an electron swarm moving through H_2 in a uniform electric field. The data used in calculating these quantities are the absolute probabilities in single collisions derived partly from experimental and partly from theoretical data, and the dependence of the mean electron energy and drift velocity on X_p^{-1} as determined by Townsend. The assumption made is that the form of the electron energy distribution is Maxwellian. Satisfactory agreement with experimental data is obtained for the energy efficiencies for the excitation of the two lowest triplet states. The total fractional energy loss is approximately constant over a wide range of X_p^{-1} and is close to unity; this result is shown to be insensitive to the adjustable constants and approximations involved. These results confirm the conclusions reached in Part I [see Abstract 4323 (1936)], and establish that, over a wide range of X_p^{-1} the actual rates of electron collision processes are, to a close approximation, those arising from a Maxwellian distribution; they also indicate that this is probably the case over a wide range of current density. AUTHORS.

***4823. Double Amplifier for the Detection of Single Thermionic Electrons. E. H. Winkler.** *Phys. Zeits.* 37. *pp.* 557–558, *Aug.* 1, 1936. —Experimental details are given of a flat ionisation chamber with double compartments for the detection of single thermionic electrons. An amplification of 2×10^5 is obtained. F. C. C.

***4824. Portable Wilson Chamber. H. Bauer.** *Phys. Zeits.* 37. *pp.* 627–629, *Sept.* 1, 1936.—A simple portable expansion chamber with rubber membrane floor and no piston is described, almost identical with the recent Wilson model. F. C. C.

***4825. Simple Wilson Chamber. H. Neuert.** *Phys. Zeits.* 37. *pp.* 629–630, *Sept.* 1, 1936.—A simple Wilson chamber is described in which the floor floats on about 500 c.c. of 50 % ethyl alcohol and water which also provides the vapour for condensation. F. C. C.

***4826. Design and Operation of Counter-Controlled Cloud Chambers. J. C. Street and E. C. Stevenson.** *Rev. Sci. Instruments,* 7. *pp.* 347–353, *Sept.,* 1936.—Two cloud chambers of the pneumatic rubber diaphragm type are described, a cylindrical one 22 cm. in dia. for use with a large electromagnet, and a rectangular one of wood with sensitive volume 35 × 30 × 10 cm. for cosmic-ray shower studies. The expansion ratio is determined by the separation of rigid diaphragm stops. A description of auxiliary apparatus for control by G-M counters and for illuminating the chambers is given. AUTHORS.

4827. Electrical Discharge in the Cloud Chamber. H. Raether. *Phys. Zeits.* 37. *pp.* 560–562, *Aug.* 1, 1936.—The onset of sparking in a homogeneous field is examined with an expansion chamber. The discharge is always of canal form but while the onset potential is independent of the time of collision for discharge through free electrons, with lightly bound electrons increasing onset potential accompanies decreasing time of collision. The mechanism appears to be that during a period of about 10^{-8} sec., the first electron produces more indirectly by photoelectric ionisation in the gas. It is considered that the self-maintained discharge at higher pressures is also due to the production of photoelectrons rather than to ionisation produced by the collision of positive ions. F. C. C.

4828. Cloud-Chamber Investigation of Electric Discharge through Gases. R. Holm. *Zeits. f. Physik*, 101. 1–2. *pp.* 138–142, 1936.—The author gives a theoretical discussion of the results of Flegler and Raether [see Abstract 2815 (1936)], in which the short sparks appearing previous to a discharge were studied. He objects to the statement that these sparks extend more slowly than one should expect and shows that their general behaviour and length can be explained. R. P.

See also Abstracts **4445, 4446, 4677, 4679, 4695, 4698, 4699, 4721, 4867, 4898.**

CONDUCTION IN SOLIDS AND LIQUIDS.

4829. Surface Conductance Measurements on Suspensions of Spherical Particles. H. Fricke and H. J. Curtis. *J. Phys. Chem.* 40. *pp.* 715–722, *June,* 1936.—A method is described for determining surface conductance from observations on suspensions of spherical particles. Suspensions of glass and kaolin of diameters from 0·6 to 3·4μ in solutions of KCl, HCl and Na_2CO_3 have been studied at frequencies from 1/2 to 100 kc. and the experimental surface conductances compared with the values calculated from a consideration of the diffuse double layer. The observed surface conductance can be accounted for on this basis only in part, the difference increasing as the frequency is increased. The existence of an additional type of current transport besides that offered by the diffuse double layer is also shown by the presence of surface capacitance, indicating a current transport (probably at the solid surface) which is associated with polarisation. There is a theoretical connection between the surface conductance and the surface capacitance, by which one can account for the frequency variation of the surface conductance. AUTHORS.

4830. Distribution of Magnetic Field around Simply and Multiply Connected Supraconductors. H. G. Smith and J. O. Wilhelm. *Roy. Soc., Proc.* 157*A*. *pp.* 132–146, *Oct.* 1, 1936.—By means of small test coils the magnetic field has been explored in the neighbourhood of two parallel supraconducting cylinders of pure tin both when they are connected at the ends to form a closed circuit and when one connection is broken. The circuit was broken by interrupting supraconductivity in one cross-bar by means of a small magnet coil wound round it. By observing the change in distribution when this magnet was turned on, the field due to current circulating in the closed circuit could be distinguished from the distorted external field, and the current strength could be measured. The success of this method of breaking the circuit shows that the so-called persistent currents are in truth circulating currents. A definite saturation value was found for the persistent current which could be induced. The closed supraconducting circuit in an external field obeyed the law that the magnetic flux through it should be constant as long as the circulating current was less than the saturation value. As the field was increased beyond this point, the current induced fell rapidly to zero, although the cylinders were still partly supraconducting. AUTHORS.

4831. Conductivity of Super-Purity Aluminium: Influence of Small Metallic Additions. G. G. Gauthier. *Inst. of Metals, J.* 59. [18 *pp.*], 1936. *Advance Copy.*—This paper deals with the effect on the conductivity of super-purity Al (exceeding 99·99 %) of additions of those elements which may occur as impurities in commercial Al. It is shown that Al follows the universal law that the conductivity and the temperature coefficient of conductivity both increase with the purity: Mathiessen's law has been confirmed. The data presented in this paper on the effect of small additions on the conductivity of aluminium are of value in that they have been determined under favourable experimental conditions, owing to the extreme purity of the basis metal and the large amount available. This high purity has made it possible to determine, with a stated accuracy, the effect of each one of the added elements in the almost complete absence of other impurities. Further, the figures given for Fe and Si, for these elements with Ti and V, and for Mg and Si, make it possible to calculate the conductivity of Al of accurately known purity. Norbury's law does not appear to hold in the case of Al. AUTHOR.

4832. Production of Metallic Films. R. V. Jones. *Journ. Sci. Instruments,* **13.** *pp.* **282–288,** *Sept.,* **1936.**—Some electrical properties of thin metallic foil made by various methods are summarised, and the merits of each process considered. The general superiority of the foil produced by rolling is emphasised. Strip of 0·1μ thickness has been made by rolling out wire of 35μ dia. A few notes on the manipulation of thin foil conclude the paper. AUTHOR.

4833. Physical Constants of Sb-Ag Alloys. W. G. John and E. J. Evans. *Phil. Mag.* **22.** *pp.* **417–435,** *Sept.,* **1936.**—Alloys are prepared by melting together the constituent metals under charcoal in a graphite pot, degasified by freezing and cast in an iron mould with graphite dressing. Up to and above 70 % Ag, chill casting and hot mould casting respectively, are adopted to ensure freedom from blowholes. Specimens are annealed at 450° C. or 550° C. and slowly cooled, the whole process taking six weeks. Resistivity rises smoothly from 36·12 (in $10^{-6}\,\Omega\,\mathrm{cm}^{-1}$) for Sb to a peak of 179·5 at 73 % Ag by weight, then falls in a stepped curve to 1·51 for 100 % Ag; the temperature coefficient shows a valley between 73 % and 80 % Ag with minimum at 78 %. Thermoelectric power against Cu between 0° and 100° C. drops fairly smoothly from 3·841 mV for Sb to −0·631 at 72 % Ag, then rises sharply to about 0·2 mV between 73 % Ag and 100 % Ag. Density varies almost linearly between

6·68 for Sb and 10·49 for Ag with a kink at about 73 % Ag. The Hall coefficient at 5800 Gauss drops smoothly from 0·226 for Sb to 0·013 at 72 % Sb, then remains about 0·001 between 73 % and 100 % Ag. Results are discussed in connection with the possible limits of Ag solid solution, ϵ, and Ag_3Sb fields. D. R. H.

4834. Ionic Conduction in Solid Salts. W. Seith. *Zeits. f. Elektrochem.* 42. *pp.* 635–654, *Aug.*, 1936.—Report on the present state of the subject under the headings: (1) experimental proof of Faraday's law, (2) temperature dependence of conductivity, separation into intrinsic and additional conductivity, (3) connection with self-diffusion, (4) directional dependence of conductivity in monocrystals, (5) the case of α-Ag_2S, (6) α-AgI, (7) thermoelectric force and thermolysis and (8) theories. R. P.

4835. A.C. Tests of the Anodic Oxide Layer on Aluminium. W. Baumann. *Zeits. f. Physik*, 102. 1–2, *pp.* 59–66, 1936.—The oxide layer formed on Al by d.c. in solutions of oxalic and succinic acids is tested with a.c. for electric leakage and dielectric constant. The effects of voltage, frequency, temperature and moisture on these properties are measured. F. J. B.

4836. Conduction Phenomena in Semiconductors. J. A. V. Fairbrother. *Roy. Soc., Proc.* 157*A*. *pp.* 50–66, *Oct.* 1, 1936.—Using a W wire coated with a layer of insulating material, a method is described whereby Langmuir probe methods of measurement in a low pressure mercury discharge can be made to yield information on the electrical behaviour of the insulating material. For pure aluminium oxide the electrical conductivity is found to vary with temperature in accordance with A. H. Wilson's theory of electronic semiconductors. The Wilson energy differences $W_2 - W_1$ is found to be 2·9 eV between 1280° K and 1725° K and 6·6 eV at higher temperatures. The critical temperature 1725° K is approximately the sintering point of alumina. Experimental evidence is given in support of the discovery of electron diffusion through alumina. Mention is made of the bearing of this phenomenon on the experiments of Reimann, Treloar, and E. F. Lowry relating to the thermionic emission from oxide coated kathodes. The conduction currents flowing across an alumina layer 0·005 in. thick between W and plasma in the forward and reverse direction are given at different temperatures for voltages up to 250 V. At high temperatures the conductivity is greater in the direction of electron flow from metal to oxide to plasma. AUTHOR.

See also Abstracts 4475, 4874, 4887, 4900.

DIELECTRICS AND CAPACITANCE.

4837. Residual Moisture in Cellulose Dielectrics. E. W. Greenfield. *Frank. Inst., J.* 222. *pp.* 345–358, *Sept.*, 1936.—The colloidal nature and structure of cellulose with particular reference to the physical and chemical properties of cable paper are discussed. Evidence from X-ray diagrams shows that the cellulose micelle maintains its unit chain individuality both in the very dry and moisture-saturated states. Thus water is held by surface forces, *i.e.*, by a process of adsorption. The factors promoting the adsorption of a liquid to a solid and, in particular, the case of the adsorption of water by cellulose are considered. From data obtained from experiments it is calculated that drying at atmospheric pressure and 100° C. ultimately eliminates all water until an equilibrium prevails with moisture distributed on the cellulose micelles as adsorbed layers of 5 mol. thickness. Drying under vacuum reduces the moisture film to monomolecular dimensions after which no more water can be removed without destruction of the cellulose structure. The application by Murphy and Lowry of the above considerations to the dielectric behaviour of hygroscopic materials is mentioned, and is stated to offer the most satisfactory explanations of dielectric absorption, apart from Maxwell's inhomogeneity theory. A. M. T.

4838. Theory of Dielectric Polarisation. J. G. Kirkwood. *J. Chem. Phys.* 4. *pp.* 592–601, *Sept.*, 1936.—The polarisation of a non-polar dielectric in a homogeneous field is investigated from a molecular point of view. A statistical calculation of the average local field in a molecule shows that fluctuations in the induced molcular moment give rise to a deviation from the Lorentz field. As a result, small but significant deviations from the Clausius-Mossotti formula are to be expected. A series expansion for $(\epsilon-1)v/3$ of the following form is obtained $(\epsilon-1)v/3 = P_0[1 + (1 + \gamma + \sigma)P_0/v + \ldots]$, where ϵ is the dielectric constant, v the molal volume and P_0 the molecular polarisation. The coefficients in the corresponding expansion of the Clausius-Mossotti formula are all equal to unity. The correction γ, arising from translational fluctuations, is about 0·1 for most substances. The correction σ depends upon the optical anisotropy of the molecule and its shape. AUTHOR.

4839. Anomalous Dielectric Constant of Higher Fatty Acids near the Solidification Point. B. Piekara. *Phys. Zeits.* 37. *pp.* 624–627, *Sept.* 1, 1936.—The solidification of stearic, palmitic and oleic acids is accompanied by a sudden increase of the dielectric constant, after which the normal decline follows. For change of wave-length from 200 to 3000 m., the jump in the dielectric constant at the moment of solidification does not appreciably change its magnitude. For the 200-m. wave-length no anomaly occurs in the dielectric constants of acetic, caprylic and chloracetic acids. In the case of a mixture of hexane and palmitic acid an analogous anomaly appears over an even wider temperature range than for the above acids. Full experimental details with apparatus, diagrams and curves showing the relationship between dielectric constant and temperature are included. H. H. Ho.

4840. Dielectric Coefficients of Gases and Vapours. K. L. Ramaswamy. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 108–133, *July*, 1936.—The dielectric coefficients of 16 gases and vapours are measured at two or three temperatures and the values are employed in calculating their electrical moments. Cyclopropane, benzene and CCl_4 are definitely nonpolar while all other substances have appreciable electric moments. The compressibility values at the ordinary temperature are determined from the variation of refractive index with pressure. Accurate values for substances which are gaseous at the ordinary temperature and pressure and approximate values for substances which are liquids under ordinary conditions, are obtained. The dielectric coefficients obtained in the present investigations are compared with the existing data by others. AUTHOR.

4841. Indian Vegetable Oils. Part II. G. N. Bhattacharyya. *Indian Journ. Phys.* 10. *pp.* 281–294, *July*, 1936.—By using a modified Nernst bridge method, the dielectric constants of seven Indian vegetable oils are measured and their electric moments evaluated by the method of binary mixture. The molecular weights of these oils are directly determined by the cryoscopic method and the results are discussed in the light of their structural formulæ. [For Part I see Abstract 3516 (1936).] AUTHOR.

4842. Electric Moments of Molecules in Liquids. L. Onsager. *Am. Chem. Soc., J.* 58. *pp.* 1486–1493, *Aug.*, 1936.—The Debye-Mossotti theory of dielectrics leads to the expectation of electrical Curie points, with attendant instability for liquids of high dielectric constant, and this is not verified experimentally. The field which acts on a molecule in a polarised dielectric may be resolved into a cavity field G, given by the shape of the molecule and proportional to the external field intensity, and a reaction field R, proportional to the total electric moment, and depending on the instantaneous orientation of the molecule. The mean orientation of the molecule is determined by the orienting force-couple exerted by G upon the electric moment μ of the molecule, and not by the average of $G + R$, because R never exerts a torque on the molecule. Since all real molecules are electrically deformable, R will enhance the electric moment of any molecule immersed in a dielectric, and the induced moment due to G will be similarly enhanced by the corresponding component of R. For a spherical molecule μ is computed as a function of the dielectric constant ϵ of the environment, and an additional " external " electric moment μ^* is considered which determines the interaction of the molecule with all distant charges and long range fields in the dielectric; μ^*/μ increases from 1 to 3/2 as ϵ increases from 1 to ∞. Both μ^* and μ approach limits, which depend on the deformability of the molecule, for $\epsilon \to \infty$; accordingly, no Curie point is expected. Formulæ for ϵ for pure polar liquids are deduced. N. M. B.

4843. Polarisation and Dielectric Constant of Liquids. J. Wyman, Jr. *Am. Chem. Soc., J.* 58. *pp.* 1482–1486, *Aug.*, 1936.—A correlation of the dielectric constant of a large number of polar liquids with assumed values of the polarisation per cc. calculated by ascribing to the molecules in the liquid state the electric moments obtained from measurements on the vapour and on dilute solutions in non-polar solvents suggests an empirical relation between polarisation and dielectric constant: $p = (\epsilon + 1)/8\cdot5$. This relation is fairly satisfactory when applied to the variation of dielectric constant with temperature and with pressure in the case of a number of polar liquids for which data are available. The meaning of such a relation in terms of the internal field in the liquid is discussed. AUTHOR.

4844. Dispersion Measurements with Short Wave-Lengths. M. v. Ardenne, O. Groos and G. Otterbein. *Phys. Zeits.* 37. *pp.* 533–544, *Aug.* 1, 1936.—By means of Drude's first method, measurements of the refractive indices are made on water, alcohols and glycerin at wave-lengths from 13·45 cm. to 50 cm. For water, dispersion bands are not observed but the beginning of anomalous dispersion is suspected at 13 cm. wave-length. Anomalous dispersion is observed with methyl alcohol, ethyl alcohol and glycerin in accordance with Debye's dipole theory. It is shown that the absorption maxima reported by other observers for nitrobenzene, *n*- and iso-butyl-alcohol cannot be attributed to anomalous dispersion. E. R.

4845. H.F. Dipole Effect in Viscous Liquids. C. Schreck. *Phys. Zeits.* 37. *pp.* 549–552, *Aug.* 1, 1936.—Viscous liquids and solid bodies do not entirely satisfy the simple dipole theory, owing to the presence of dipoles of different relaxation times and the effect of viscosity. Assuming dipoles of different relaxation times, dielectric constant/frequency and power loss/frequency relations are derived which show good agreement with the experimental results on concentrated laevulose solutions. The influence of viscosity accounts for the results obtained by Jackson on chlorinated diphenyl [see Abstract 310 (1936)] and by the author on a similar material and glycerin. With these materials the dipole loss reaches a maximum shortly before solidification. E. R.

4846. Absorption in Dipole Liquids of 3–7 Metre Waves. E. Keutner. *Ann. d. Physik*, 27. 1. *pp.* 29–48, *Sept.*, 1936.—A method is described of measuring the absorption in dipole liquids of wave-lengths of 3–7 m., use being made of the electrolytic thermometer and maintenance of a constant current in the measurement circuit. Possible sources of error and their elimination are discussed. The alcohols, ethyl to hexyl alcohol were investigated and also mixtures of glycerin with water, nitrobenzene, acetone and chlorbenzene. The results obtained for the alcohols were in quantitative agreement with earlier measurements and with the dipole theory. The absorption phenomena in the case of glycerin and nitrobenzene did not agree, however, with the simple formula of the Debye theory, but they agreed with the measurements of earlier investigators. A. M. T.

4847. Anomalous Properties of Dielectrics. J. Neufeld. *Frank. Inst., J.* 222. *pp.* 327–336, *Sept.*, 1936.—The causes of energy losses in dielectrics subjected to alternating stress are not completely understood. One of the most satisfactory methods of treating these problems, due to von Schweidler, attributes the dielectric loss entirely to dielectric absorption. Some agreement between the methods of von Schweidler and experimental data has been found by F. Tank, J. B. Whitehead and R. R. Benedict. However, there does not exist a satisfactory test of the accuracy of the analysis of von Schweidler. The present paper gives : (1) a method of separating the losses due to hysteresis from the losses due to absorption in dielectrics ; (2) a method for determining analytically the absorption curve of a dielectric in which hysteresis is absent ; and (3) a graphical method of checking the accuracy of von Schweidler's analysis. AUTHOR.

See also Abstracts 4739, 4743, 4769, 4868.

ELECTROCHEMISTRY.

***4848. Stability of Standard Cells. P. Vigoureux.** *Journ. Sci. Instruments*, 13. *pp.* 297–298, *Sept.*, 1936.—Measurements made with "acid" cadmium cells show that atmospheric variations of temperature do not affect the secular constancy of the e.m.f. of the cells. For field work, constancy of temperature is necessary only just before, and during, the measurements. AUTHOR.

4849. Sodium Amalgam Concentration Cells with Non-Aqueous Solutions. H. Ulich and G. Spiegel. *Zeits. f. phys. Chem.* 177. *Abt.A.* 2. *pp.* 103–115, 1936.—A dropping electrode giving results independent of outflow speed is used. Special precautions are necessary to avoid the vitiating effect of impurities, especially O_2 and H_2O. The cell Na amalgam (c_1) | ($N/10$) NaI | Na amalgam (c_2) gives with acetone, pyridene and methanol as solvents, results similar to those with water. With acetonitrile solution there are some deviations. For the double cell Ag | AgCl | NaCl (c_0) | Na amalgam (0·0382 %) | NaCl (c) | AgCl | Ag $E = A \log (a/a_0) = A \log (cf/c_0f_0)$, *i.e.*, $y = E - A \log c = A\{\log f - \log (c_0f_0)\}$. $A = 2 \times 2{\cdot}303\ RT/F$. For $c = 0$ $f = 1$ and $y_{c=0} = -A \log (c_0f_0)$. For very small values of c, $\log f = -B\sqrt{c}$, B being a constant which may be calculated from Debye and Hückel's theory. Hence

$y = -A\{B\sqrt{c} + \log(c_0 f_0)\}$. By extrapolation of the plot of y against $\sqrt{c}$, $y_{c\to 0}$ may be found, and the activity coefficient can be obtained from the formula $(y - y_0)/A = \log f$. In very dilute solutions disturbances occur and since experimental results are only relative, the absolute values of $\log f$ cannot be definitely established. D. R. H.

4850. Physical Characterisation of Dissolved Ions. Part II. J. Lange. *Zeits. f. phys. Chem.* 177. *Abt.A.* 3. *pp.* 193–212, 1936.—As a result of freezing-point and conductivity determinations by the previous method of solutions of concentrations 0·001–0·1–*M* of the chlorides and iodides of Li, K and Cs the relations $1 - f_0 = 0\cdot37\sqrt{c} + B_0 c$ and $1 - f_\mu = (0\cdot219 + 29\cdot5/\Lambda_0)\sqrt{c} + B_\mu c$ respectively were established for values of $c \ngtr 0\cdot05 - M$, where f_0 and f_μ are the osmotic and conductivity coefficients, and B_0 and B_μ constants. B_0 and B_μ consist of two portions: a negative depending on the finite extension of the ions, and a positive due to the mutual attraction of the ions consequent on disturbance in the electronic rotation [see Abstract 1464 (1931)]. This latter portion is greater in B_μ than in B_0. In the alkali salts with their smaller polarisability the influence of the negative portion predominates to such an extent as to make B_0 approximately $= B_\mu$ in them, but in the tetraalkyl salts previously examined the positive portion is much more important, thus explaining their different behaviour. [For Part I see Abstract 2169 (1934)]. C. A. S.

4851. Electrolytic Dissociation of Heavy Water. W. F. K. Wynne-Jones. *Faraday Soc., Trans.* 32. *pp.* 1397–1402, *Sept.,* 1936.—The dissociation of D_2O is determined from e.m.f. measurements at 15°, 25° and 35°. At 25° the ionic product of D_2O is $1\cdot95 \times 10^{-15}$ while that of ordinary water is $1\cdot0 \times 10^{-14}$. From the temperature coefficient the heat of ionisation is calculated to be 940 cal. greater than that of ordinary water and this difference exactly accounts for the difference in the ionic products. AUTHOR.

4852. Transference Number of Lanthanum Chloride. G. Jones and L. T. Prendergast. *Am. Chem. Soc., J.* 58. *pp.* 1476–1482, *Aug.,* 1936.—The transference numbers of the lanthanum ion in lanthanum chloride solutions have been determined by the analytical method at 25° at eleven concentrations over a range of 0·0038 to 1·0 *M.* The transference number varies from about 0·47 to 0·30 over this range. Several equations purporting to express the transference number as a function of the concentration and the problem of extrapolation of transference numbers to infinite dilution are discussed. AUTHORS.

4853. Variations of E.M.F. of Solutions of Iron on Application of a Mechanical Force. L. Giulotto. *N. Cimento,* 13. *pp.* 220–226, *May,* 1936.—Investigations are made of the variations of e.m.f. due to traction on an iron wire in a solution of ferrous sulphate and forming the electrode of a cell. E.m.f.s variable with time are found and are not considered to be due to thermal effects. J. J. S.

4854. Kathode Polarisation as Function of Current Density in Fused Salts. S. Karpatschoff and O. Poltoratska. *J. Phys. Chem.* 40. *pp.* 763–768, *June,* 1936.—By determining the p.d. (E) between the kathode and an auxiliary electrode when current of density D ($\ngtr$ 1 A/cm.^{2}) passes between kathode and anode (both of C) in molten $PbCl_2$ or $CdCl_2$, curves relating E to D (and so showing the variations in kathode polarisation) were traced. In both cases E becomes negative at a certain value of D. The positive portion is due to the slowness of diffusion of Pb or Cd ions from the kathode in the electrolyte. The negative portion (expressible by the equation $E = a - RT \log D/2F$ (a a constant) is attributed to the slowness of the condensation of atoms of Pb or Cd formed at the kathode in the liquid. [See Abstract 196 (1926).] C. A. S.

4855. Oxidation Processes at the Kathode. O. K. Kudra and K. N. Ivanov. *J. Phys. Chem.* 40. *pp.* 769–777, *June*, 1936.—The black powdery deposits formed when solutions containing Cu, Zn, Cd or Ag are electrolysed under certain circumstances (usually with high c.d. and dilute solution) are shown by X-ray examination to consist usually of metal and oxide, the amount of oxide depending mainly on the oxidising properties of the anion, being much greater from a solution of the nitrate than from one of the chloride. It also depends on the metal. Thus (from solutions of the nitrates) in the cases of Zn, Cd, Cu and Ag, 97, 50 (probably as Cd_2O), 40 (as Cu_2O only) and 0 % appear as oxide respectively. H_2 absorption by the metal is also indicated. The spongy deposits formed, usually with very low c.d., have a similar constitution. C. A. S.

4856. Potential of the Mercury Electrode in Solutions of Different Ions. T. Erdey-Grúz and P. Szarvas. *Zeits. f. phys. Chem.* 117. *Abt.A.* 4. *pp.* 277–291, 1936.—The potentials of the stationary and slowly dropping Hg electrodes are determined in Hg free solutions and in solutions containing different ions. The potential of the stationary Hg electrode is decided by the adsorption of the anions present in the solution. The greater the capillary activity of the anion, the more the potential became negative, and better defined. The potential of the Hg electrode in solutions of different ions, varies approximately linearly with the logarithm of the concentration of the anions. F. J. B.

4857. Electrode Potentials of Dilute Amalgams. T. Erdey-Grúz and A. Vázsonyi-Zilahy. *Zeits. f. phys. Chem.* 177. *Abt.A.* 4. *pp.* 292–305, 1936.—The dependence of the potential of Me-amalgam/Me-salt solution upon the concentration of the amalgam is measured in Hg free solutions. The dilute amalgams are employed as stationary and dropping electrodes. With the stationary electrodes three ranges are recognised. In the first range up to a concentration of 10^{-6} gm. atom/l. the potential is independent of the concentration of the amalgam. In the second range, between 10^{-6} to 10^{-5}, the potential changes with the concentration to a greater extent than is demanded by the Nernst formula. In the third range between 10^{-5} to 10^{-4} the potential measured is in agreement with that calculated from the Nernst formula. F. J. B.

4858. Effect of Pressure on the Electrode Potential in the Electrolysis of Water. V. Schischkin and E. Karnauch. *Zeits. f. Elektrochem.* 42. *pp.* 693–695, *Sept.*, 1936.—The influence of the increase of pressure on the kathode and anode potentials of Ni electrodes during the electrolysis of 5 $N \cdot NaOH$ is investigated. The pressure ranges were from 0 to 100 and from 0 to 10 kg./sq. cm. The results show that the overvoltage of the liberation of H_2 and O_2 on Ni decreases somewhat as the pressure increases. F. J. B.

4859. Polarographic Investigations of Anhydrous Acetic Acid Solutions. D. MacGillavry. *Faraday Soc., Trans.* 32. *pp*, 1447–1450, *Sept.*, 1936.—A first report is given on polarographic investigations with the dropping mercury kathode of solutions of anhydrous acetic acid. Oxygen does not cause maxima in the complete absence of water. The polarograms of dilute solutions are practically straight lines, showing no waves or breaks characteristic of the ions in solution. The polarograms of a more concentrated solution of $NaCH_3CO_2$ show a sharp bend at about 2 volts and a straight continuation above 2 volts. The small wave below 2 volts may be due to mercury. The polarograms obtained are discussed and compared with those of aqueous solutions and of the pure solvents water and acetic acid. AUTHOR.

4860. Electrochemical Concentration Measurement. F. Lieneweg. *A.T.M.* 6. *T*90–*T*91, *July*, 1936.—Various applications of electrical measurements to the determination of pH, the concentration of other ions and of electrolytes, and the control of various operations (neutralisation, oxidation-reduction, Cl_2- and CO_2-content, boiler feed-water, sewage treatment, etc.) are briefly described, with some account of the necessary precautions. C. A. S.

See also Abstracts 4456, 4472, 4796, 4835, 4897.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4861. Envelopes of Kikuchi Lines. M. v. Laue. *Phys. Zeits.* 37. *pp.* 544–547, *Aug.* 1, 1936.—The theory of Kikuchi lines is extended to the envelopes [see Abstract 1852 (1936)]. It is suggested that the electrons in the Kikuchi lines have been inelastically scattered, so that the effective source of radiation is within the diffracting crystal, and comparison is made with the X-ray diffraction effects occurring when a single crystal is used as antikathode [see Abstract 2150 (1935)]. It is believed that the bands are cross-grating diffractions due to the surface layer of atoms, and a possible application of electron diffraction for detecting structural faults in crystals is outlined. A. G. Q.

4862. Scattering of Fast Electrons by Helium. A. L. Hughes and S. S. West. *Phys. Rev.* 50. *pp.* 320–325, *Aug.* 15, 1936.—The scattering of 2000 and 4000 V electrons by He atoms is examined, the ratio of the scattering by the atomic electrons to that by the nucleus being observed. The results are in quantitative agreement with wave-mechanical theory. Conversely, the results show that the velocity of the atomic electrons has a value close to that given by the Bohr theory. F. C. C.

4863. Velocity Distribution of Atomic Electrons by the Method of Electron Impact. G. E. M. Jauncey. *Phys. Rev.* 50. *pp.* 326–327, *Aug.* 15, 1936.—When gas atoms are bombarded with electrons travelling with a speed which is large compared to the orbital speeds of the atomic electrons, a bombarding electron collides either with the nucleus or an atomic electron. In the latter case the distribution-in-energy of the electrons scattered at a given angle gives directly the distribution-in-component-velocity of the atomic electrons. The two distribution functions are of the same form. AUTHOR.

4864. Graphical Determination of the Orbits of Electrons in a Magnetic Field. J. Dosse. *Zeits. f. techn. Physik,* 17. 9. *pp.* 315–318, 1936.—The electron-optical law of refraction which permits a simple graphical determination of electron orbits in plane and circular symmetrical electric fields is applied to the tracing of electron orbits in circular symmetrical magnetic fields by using the potential function which is easily deduced from the vector potential or magnetic field function. By way of example electron orbits are derived for the homogeneous magnetic field and the magnetic field of a thin circular conductor. The method of procedure in more complicated cases is indicated. J. E. K.

***4865. Electron-Optical System of Two Cylinders as Applied to Kathode-Ray Tubes. D. W. Epstein.** *I.R.E., Proc.* 24. *pp.* 1095–1139, *Aug.*, 1936.—The electron beam of a kathode-ray tube is usually focused by means of an electron-optical system of two coaxial cylinders. This paper presents a detailed treatment of such a focusing system and is divided into two parts. Part I, Geometric electron optics of axially symmetric electrostatic fields, deals with (1) the analogy between light and electron optics, (2) the motion of electrons in axially symmetric electrostatic fields, (3) the definition and determination of positions of cardinal points due to axially symmetric electrostatic fields, and (4) thick and thin lenses. Part II, Lenses equivalent to the electrostatic fields of two coaxial cylinders, deals with (1) the positions of the cardinal points due to the two coaxial cylinders of various diameters and at various voltages, (2) the use of such cardinal points, (3) the experimental determination of the positions of the cardinal points, and (4) the spherical aberration of the electrostatic field due to the two cylinders. The results are applied to the kathode-ray tube throughout the discussion. AUTHOR.

***4866. Phase-Angle Measurements by Kathode-Ray Oscillograph. O. Schäfer.** *Zeits. f. techn. Physik*, 17. 8. *pp.* 266–269, 1936.—An arrangement of apparatus is described consisting essentially of a suitably driven rotating switch, whereby two curves are traced alternately and in rapid succession on the screen of a kathode-ray oscillograph. One curve may, for example, be in phase with the voltage applied to an electrical circuit under examination and the other in phase with the current flowing. The alternations being sufficiently rapid simultaneous traces of the voltage and current variations are portrayed. In most practical cases the arrangement has little effect on the obtaining conditions when switched in or out of circuit, and in this respect has an important advantage over other phase-indicating devices. C. C.

4867. Photographic Action of Slow Protons. R. Kollath. *Ann. d. Physik*, 26. 8. *pp.* 705–722, *Aug.*, 1936.—Gives the results of an examination of protons of 30–1000V on photographic plates, the protons being produced by the "lithium" method [see Abstract 2789 (1931)]. With different gelatin plates and films the central black part is surrounded by a small area of unblackened emulsion and this in its turn is surrounded by a black halo. These haloes are due to the deflection of the protons from their original direction by the positive charge of the layers caused by the first protons. Schumann plates on Ag do not, however, show this effect. An examination of the proton action on Schumann plates showed that the reciprocity law is valid in the region examined, and the blackening is at first proportional to the number of protons falling on the plate and then falls away to smaller values, marked deviations from the straight line part appearing below 100 V. Relative sensitivities of Schumann plates to protons are given for proton energies between 30 and 1000 V, the absolute sensitivity being obtained for 350–V protons. Finally the photographic action of protons and electrons on Schumann plates is compared, approximately the same high absolute sensitivity being found to slow protons as to slow electrons of the same energy. R. C. F.

See also Abstracts **4437, 4451, 4471, 4473, 4488, 4560, 4817.**

ELECTROSTATICS.

***4868. Split Cylindrical Condenser. E. P. Adams.** *Am. Phil. Soc., Proc.* 76. 3. *pp.* 251–302, 1936.—A mathematical examination of the condenser formed by the longitudinal splitting of a cylinder into two equal parts. Capacitance and electric distribution at all parts are derived. Previous work [see Abstract 5221 (1935)] is referred to. Other electrode forms are then considered, based on split cylinders with different radii, etc. Higher mathematics is used throughout and no useful summary is possible.
E. H. W. B.

See also Abstracts 4767, 4788, 4922.

MAGNETISM AND ELECTROMAGNETISM.

4869. Magneto-Caloric Effect in the Honda-Ôkubo Theory of Ferromagnetism. K. Honda and T. Hirone. *Zeits. f. Physik,* 102. 1–2. *pp.* 132–137, 1936.—The reversible part of the magneto-caloric effect is represented as the sum of two terms; the first is connected with the magnetostriction on the assumption that the change of volume produced by the magnetic field causes an energy increase which is related to the latent heat of melting by the ratios of the volume changes. The second term is due to the direct action of the field on the elementary magnets, which are supposed to rotate about an axis perpendicular to the field. The formula is compared with the experiments of Okamura [see Abstract 2880 (1936)] on Ni, Co and Fe alloy, and agrees qualitatively.
R. P.

4870. Determination of Curie Points of Ferromagnetic Substances. L. Bergmann. *Phys. Zeits.* 37. *pp.* 547–548, *Aug.* 1, 1936.—The test specimen, in the form of a thin rod, is placed inside a coil of several thousand turns of fine wire. Round this is wound a magnetising coil connected to a battery, adjustable resistance and ammeter. The inner secondary coil is connected to a l.f. amplifier which leads to a rectifier and galvanometer. The rod is bored to hold a thermoelement, and the rays from an arc lamp are concentrated on the end of the rod by two lenses. Between the lenses a perforated rotating disc interrupts the rays 500 to 1000 times per sec. The rod is heated above the Curie point and inserted in the coil. When the Curie point is reached, the periodic heating of the rod by the lamp rays causes magnetic changes which set up induced currents of the same frequency. These currents are amplified and rectified, and can be recorded photographically if a mirror galvanometer is used. The method gave 345° for Ni and 110° C. for monel metal.
G. E. A.

4871. Magnetic After-Effect. H. Kindler and A. Thoma. *Arch. f. Elektrot.* 30. *pp.* 514–527, *Aug.* 14, 1936.—Gives a comprehensive review of theoretical and experimental work on magnetic after-effect, dealing particularly with Jordan's application of the theory of elastic and dielectric after-effect to explain the magnetic power losses in weak fields not attributable to hysteresis and eddy-currents; with ballistic and a.c. methods of measuring magnetic after-effect and the laws derived from the experimental results; and with suggested explanations of the effect, based on magnetostrictive stresses (Steinhaus and Kussmann), additional eddy-current losses due to inhomogeneous structure (Goldschmidt) and the retardation of Barkhausen reversals through the influence of thermal fluctuations and of local eddy-currents (Preisach). C. E. W.

4872. Variations of the Magnetic Moment of the Cobaltous Ion in the Anhydrous Chloride and in the Mixed Crystals $CoCl_2$-$CdCl_2$ and $CoCl_2$-$MnCl_2$. G. Foex and C. Fehrenbach. *Comptes Rendus,* 203. *pp.* 307–309, *July* 27, 1936.—$CoCl_2$ has a Curie point at 136° C. The cobaltous ion exhibits a transition from dia- to para-magnetism.
W. R. A.

4873. Magnetic Anisotropy of Nickel-Cobalt Single Crystals. J. W. Shih. *Phys. Rev.* 50. *pp.* 376–379, *Aug.* 15, 1936.—The magnetic anisotropy of Ni-Co single crystals in the face-centred cubic range has been investigated with a pendulum magnetometer. The direction for easiest magnetisation changes from $< 111 >$ to $< 100 >$ as the Co content increases from 3 to 10 % and changes back to $< 111 >$ when Co is more than 20 %. Powell and Fowler's theory in regard to the relations between the direction of easiest magnetisation and the crystalline structure, is again inadequate to explain these results, as in the case of Fe-Co alloys. The anisotropy constants were calculated both from these monocrystalline specimens of Ni-Co alloys and from the polycrystalline specimens tested by H. Masumoto. The discrepancy between the two sets of values is too large to be accounted for by experimental errors in the present work.
AUTHOR.

4874. Permeability Measurements Based on Skin-Effect. R. Becker. *Ann. d. Physik,* 27. 2. *pp.* 123–128, *Sept.,* 1936.—Resistance and inductance measurements on an iron wire carrying h.f. a.c. yield different values of permeability [see Abstracts 3221 (1931) and 3819 (1933)]. A mathematical analysis shows that the differences observed can be explained by hysteresis and magnetic after-effect. C. E. W.

4875. Magnetism and Cold-Working in Metals. Part I. Polycrystals. S. R. Rao. *Indian Acad. Sci., Proc.* 4*A. pp.* 37–53, *July,* 1936.—The effect of cold-working on the susceptibilities of Bi, Zn, Cd and Sn is studied. The diamagnetic susceptibility of Bi is lowered effectively while Zn and Cd show a small decrease. The paramagnetic susceptibility of white Sn shows a decrease as the density decreases due to cold working and changes sign below a particular density value. The nature of polycrystalline metals is examined and attention is drawn to the existence of a deformed boundary between the small crystals in the metal specimen. Natural explanations are offered for the observed susceptibility changes in the light of the existence of the distorted layer and of the author's work on metallic colloidal powders [see Abstract 5248 (1934)]. AUTHOR.

4876. Mass Susceptibilities of Binary Alloys of Ag with Sb, Bi and Pb. G. O. Stephens and E. J. Evans. *Phil. Mag.* 22. *pp.* 435–445, *Sept.,* 1936.—Cylindrical bars are cast from alloys prepared by melting together the constituent metals under charcoal; and annealed at suitable temperatures up to 780° C., decided from the constitution diagrams, in evacuated quartz or hard glass tubes. Susceptibility is measured against pure water ($-\chi \times 10^{-6} = 0{\cdot}72$) as standard, on a Curie-Cheneveau balance at room-temperature. In the Ag-Sb series, $-\chi \times 10^{6}$ changes fairly smoothly from 0·95 for Sb, to a valley at 0·19 and 78 % Ag, then moves irregularly, with peaks at 0·26 and 83 %, at 0·25 and 89 %, at 0·21 and 97 %; and valleys at 0·23 and 84 %, at 0·19 and 94 %. Ag-Pb alloys give a straight line between 0·118 for Pb and 0·197 for Ag. For Ag-Bi alloys $-\chi \times 10^{6}$ rises from 1·40 for Bi to 1·46 at 2·5 % Ag, then falls smoothly to 0·44 at 94 % Ag where a break occurs, then falls more rapidly. Results agree with older determinations. D. R. H.

4877. Diamagnetic Anisotropy of Crystals in Relation to their Molecular Structure. Kathleen Lonsdale and K. S. Krishnan. *Roy. Soc., Proc.* 156*A. pp.* 597–613, *Sept.* 1, 1936.—The paper summarises the mathematical relationships between crystal and molecular diamagnetic susceptibilities and molecular orientations, for the different crystal systems. Special reference is made to the large plane aromatic molecules, whose arrangement in the crystalline state has proved most amenable to accurate determination by X-ray methods. Attention is drawn to an error in the deductions from magnetic measurements, made in previous publications [see Abstract 2751 (1935)], which has led to a fictitious discrepancy in the results of magnetic and X-ray determinations of molecular orientations. The two methods actually give closely consistent results. AUTHORS.

4878. Magnetic Properties of Bismuth. Parts I and II. D. Shoenberg and M. Z. Uddin. *Roy. Soc., Proc.* 156*A. pp.* 687–720, *Sept.* 1, 1936.—In Part I the detailed temperature dependence of the principal susceptibilities of Bi single crystals has been investigated from room-temperature down to 14° K. The crystals were prepared by a special method and the measurements made with a Sucksmith balance. This temperature dependence is considerably changed by the addition of small concentrations of other elements to the Bi, and these changes are discussed in connection with the general interpretation of the temperature dependence. The effect of alloying on the susceptibility at a low temperature is also discussed. In Part II a detailed investigation has been made of the peculiar periodic field dependence of susceptibility found by de Haas and van Alphen for Bi at low temperatures. The experimental methods were the same as for Part I. At the temperature of liquid He the effect became very pronounced, while measurements at higher temperatures showed that for fields up to 10,000 gauss the effect disappears at about 40° K. The alloying of very small concentrations of other elements (Pb, Sn, Te, and Sb) was shown to have a remarkable influence on the field dependence, changing both the position and the magnitude of the singularities. These new results are discussed in connection with Peierls's theory of the field dependence [see Abstract 2623 (1933)] and qualitatively interpreted, though quantitative agreement is not obtained. Combining the results with those of Part I on ordinary susceptibilities, some empirical conclusions are drawn as to how alloying influences the electronic structure of pure Bi. AUTHORS.

4879. Magnetic Properties of Chromium. L. F. Bates and A. Baqi. *Phys. Soc., Proc.* 48. *pp.* 781–794, *Sept.* 1, 1936.—Pure Cr is prepared from Cr amalgam and its magnetic susceptibility is studied over the temperature range 90 to 620° K. The mass susceptibility is practically constant over this range, the slight departures from constancy being partially explainable by the effects of thermal expansion on the experimental results. The mean susceptibility is $3{\cdot}08 \times 10^{-6}$ e.m.u. per gm. at room-temperature. The effects of impurities on the magnetic behaviour of Cr, which are very pronounced in the case of samples prepared at lower temperatures, are considered in detail, and the thermal and magnetic data for this element are discussed on the basis of modern theories of paramagnetism of metals. AUTHORS.

4880. Magnetic Properties of Amalgams. L. F. Bates and L. C. Tai. *Phys. Soc., Proc.* 48. *pp.* 795–809, *Sept.* 1, 1936.—The magnetic susceptibilities of a series of amalgams of known concentrations of Bi, Cr, Cu and Mn with Hg are studied at room-temperature, the Gouy method of measurement being employed in all cases. A study of the drop-weight method of measuring susceptibilities showed it to be quite unreliable for measurements with amalgams. In dilute amalgams Mn was found to possess an apparent atomic susceptibility of $+ 13{,}700 \times 10^{-6}$, Bi $+ 133 \times 10^{-6}$, Cr $+ 23 \times 10^{-6}$ and Cu about $- 7{\cdot}3 \times 10^{-6}$ e.m.u. All metals so far studied which are diamagnetic in the solid state are paramagnetic in dilute amalgams, with the possible exception of Cu.
AUTHORS.

4881. Constant Paramagnetism. Parts I and II. D. P. Raychaudhuri and P. N. Sengupta. *Indian Journ. Phys.* 10. *pp.* 245–266, *July,* 1936.—The constant atomic susceptibilities of the elements V to Mn are found to depend on the number of electrons in the *d* shell in a manner analogous to the dependence of the Bohr magneton numbers for these elements. The temperature coefficient of susceptibility has a very low negative value for compounds like V_2O_5, $KMnO_4$, while it has a higher positive value for $K_2Cr_2O_7$. Susceptibilities of V_2O_5 in the amorphous and the crystalline states are different. From a study of the coordination compounds of the different transition series of elements it is found that the atomic magnetic susceptibility of the magnetogenetic atom is not a constant. It has a higher value when the groups associated have a high dipole moment. For simple compounds the value depends on the type of binding as also on the element in combination. AUTHORS.

4882. Theory of Constant Paramagnetism. Application to Manganese. L. Néel. *Comptes Rendus,* 203. *pp.* 304–306, *July* 27, 1936.—Theoretical. W. R. A.

4883. Paramagnetism of Rare-Earth Sulphates at Low Temperatures. L. C. Jackson. *Phys. Soc., Proc.* 48. *pp.* 741–746, *Sept.* 1, 1936.—The magnetic susceptibilities of powdered specimens of the octahydrated sulphates of Yb, Dy and Er are measured from room-temperature down to 14° K. The results are discussed in terms of the crystalline-field theory of Penney and Schlapp. Measurements on $Nd_2(SO_4)_3 \cdot 8H_2O$ support the observations of Gorter and de Haas as against those of Selwood.
AUTHOR.

4884. Electromagnetic Field Due to a Moving Electrified Sphere. G. A. Schott. *Roy. Soc., Proc.* 156*A*. *pp.* 471–503, *Sept.* 1, 1936.—The mechanics of electrified systems is developed on a rigorous basis in view of the failure to account for some nuclear phenomena by quantum mechanical methods [see Abstract 1645 (1933)]. Exact expressions in the form of single definite integrals are obtained for the scalar and vector potentials and the electric and magnetic forces inside and outside the sphere for a spinless motion with speeds less than that of light but otherwise unrestricted, and are checked by comparison with the known expressions for the Abraham electron in uniform rectilinear motion. Application to the case of hyperbolic rectilinear motion leads to the result that the magnetic force inside the sphere always vanishes. The forces are also found for the general motion at a point on the surface of the moving sphere, and the mechanical force per unit charge is deduced, this being needed for the determination of the total mechanical reaction on the sphere, due to its own electromagnetic field for any spinless motion at a speed less than that of light. In Part II a rigorous and exact expression, depending on a single definite integral, is found for this. For uniform acceleration a finite expression involving the velocity and acceleration is obtained for the reaction, also a series in ascending powers of the acceleration, each term of which can be got from the preceding one by differentiation; the first and second terms coincide with those given by Abraham for the perfectly conducting sphere in quasi-stationary rectilineal motion. A finite expression is also found for the case of hyperbolic rectilinear motion, which is the negative of the product of the acceleration and longitudinal electromagnetic mass of Abraham; there are no terms of higher order such as the radiation pressure term of Abraham. The expression for the mechanical reaction is then applied to discontinuous motions, in which the law of the velocity changes suddenly owing to the action of external forces, but its magnitude is continuous. It is found that there is always a lag between the change in the law of the velocity and the consequent change in the law of the reaction. When applied to the small longitudinal disturbance of uniform rectilinear motion it gives exponential damping of the disturbance, dead beat when there is no intrinsic mass, indicating stability and a failure of the classical principle of conservation of momentum. N. M. B.

4885. Mass of a Convected Field and Einstein's Mass-Energy Law. W. Wilson. *Phys. Soc., Proc.* 48. *pp.* 736–740, *Sept.* 1, 1936.—Certain discrepancies between the results of the usual mode of calculating the mass (more particularly the electromagnetic mass) of a charged conductor and Einstein's mass-energy law are discussed and explained.

AUTHOR.

4886. Magnetic Viscosity at Different Points of the Magnetisation Curve. A. Mitkevitch. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 5. *pp.* 175–177, 1936. *In English.*—In an investigation of a ring made of shellac-coated iron wire of 0·1 mm. dia. with H_c 14 oersteds, which had been brought into a cyclic state, the following results were obtained. The intensity of the effect of magnetic viscosity is not the same at all parts of the magnetisation curve, but reaches a maximum at the steepest part. The change of magnetic induction caused by magnetic viscosity falls off exponentially with the time. In certain cases, notwithstanding the comparatively large previous change of induction from $-B_m$ to $+B_m$, magnetic viscosity at $+B_m$ depends on the time during which $-B_m$ was constant. Magnetic viscosity in the initial section of the magnetisation curve differs qualitatively from those in the second and third sections, being far more affected by the previous time intervals, *i.e.*, by magnetic history. [See also Abstract 2889 (1936).] G. E. A.

4887. Power-Loss and Electromagnetic Shielding Due to the Flow of Eddy-Currents in Thin Cylindrical Tubes. C. W. Oatley. *Phil. Mag.* 22. *pp.* 445–453, *Sept.*, 1936.—The induction of eddy-currents in thin cylindrical tubes, by the action of an alternating magnetic field parallel to the axis of the tube, is investigated mathematically. Formulæ are obtained for the power dissipated in such tubes and for the electromagnetic shielding due to them.

AUTHOR.

***4888. Screening of Transformers against Electromagnetic "Pick-Up" Effects. J. E. R. Constable and G. H. Aston.** *Journ. Sci. Instruments*, 13. *pp.* 295–297, *Sept.*, 1936.—Measurements made upon the reduction of "pick-up" obtained by enclosing an intervalve transformer in boxes constructed from various materials are described. It is concluded that high permeability alloy $\frac{1}{16}$ in. thick is of the greatest all-round value for screening transformers, particularly as regards the low frequencies. At medium audio-frequencies $\frac{1}{4}$-in. thick screens of other materials such as cast iron, aluminium or brass are also of value.

AUTHORS.

4889. Effect of Tension, Pressure and Torsion on Length-Magnetostriction. H. Kirchner. *Ann. d. Physik*, 27. 1. *pp.* 49–69. *Sept.*, 1936.—The magnetostriction in length was measured, by a new method, for Ni with 0·05 % Be and two Ni-Fe alloys containing 15 and 50 % Ni respectively. Becker and Kersten's theoretical result was verified for Ni that the magnetostriction with tension is 3/2 times as great as with no tension. With a compressing load the magnetostriction sinks nearly to zero, and torsion reduces it to 0·72 of its initial value. The law: $\lambda = c(I^2 - I_0^2)$, where λ is the magnetostriction and I, I_0 the field intensities, was verified for three different tensions and for torsion. The same measurements were made with the two Ni-Fe alloys. Their behaviour under tension and pressure is the reverse of that of Ni. Under torsion the magnetostriction is reduced to 3/4 of the value without torsion. The experimental values agree with those required by theory. G. E. A.

4890. Measurement of Coercive Force on Small Specimens. J. L. Snoek. *Physica*, 3. *pp.* 855–858, *Aug.*, 1936. *In German.*—A small magnetised specimen suspended in a demagnetising field tends to rotate so long as the field-strength is less than the coercive force, which is thus simply determined by noting the field-strength at which this instability ceases. For materials of low coercive force the periodic time of oscillation in the field is measured, the field-strength at which the period is the same as in zero field giving the coercive force. If the dimension-ratio of the specimen in the horizontal plane is small, the measured coercive force is too high, but if the ratio exceeds 10 the measurement is accurate within 2 %. Since the vertical dimension has little influence, a flat plate can be tested by suspending it with its plane vertical. C. E. W.

See also Abstracts 4491, 4545, 4769, 4908, 4909.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***4891. H.F. Apparatus for Producing a Measured Heat Stimulus. A. Hemingway and G. H. Witts.** *Physics*, 7. *pp.* 299–301, *Aug.*, 1936. —The requirements of a h.f. diathermy machine for clinical therapy and for studies of physiological temperature regulation in regard to (1) frequency, (2) measurement of power output, (3) range of power output, (4) efficiency and construction are discussed. To conform with the above requirements a power oscillator of 1000 kc. has been built capable of delivering up to 200 W of h.f. power. A description of the apparatus is given with circuit constants and meter values which have been found useful in physiological temperature studies on animals and human subjects. With this apparatus it is possible to measure the power consumption of a subject treated with diathermy from the voltmeter and ammeter readings.

AUTHORS.

4892. Diagnostic Radiographs, with and without Potter-Bucky Diaphragms. W. Watson. *Radiography*, 2. *pp.* 114–122, *Aug.*, 1936. —Discusses in some detail the technique of radiography of thick parts of the body, with special reference to the avoidance of scattered radiation. The use of cones to limit the beams of radiation is mentioned, and tests as to their efficiency are given. In the discussion on Potter-Bucky diaphragms certain defects are noted, and the causes of grid-lines and irregular densities investigated. The latter are shown to be mainly due to improper centring of the tubes with curved diaphragms, and the former to stroboscopic effects. G. E. B.

***4893. Complete Processing Unit with Thermostatic Control. J. K. Bray.** *Radiography*, 2. *pp.* 133–136, *Sept.*, 1936.—Describes a unit for developing and fixing hospital radiographs, and consisting of developing, stopping and fixing baths and a washing tank. The three baths are contained in a lead-lined teak tank to give a large thermal lag, the space between the tank and baths being filled with water when temperature is controlled by a thermostat. The heater is of the immersion type, and the thermostat comprises a disc thermometer and a Birka regulator. Complete details of the unit are given. G. E. B.

***4894. Physical Instruments in X-Ray and Radium Therapy. W. V. Mayneord.** *Journ. Sci. Instruments*, 13. *pp.* 245–251, *Aug.*, 1936.—The problem of the measurement of X-ray and γ-ray doses by ionisation methods is briefly discussed, and a short description of a standard ionisation chamber given. A number of practical X-ray dosemeters are described, including the simple ionoquantimeter, the "Victoreen," the "Hammer" and the "Mekapion" dosemeters, together with dosage rate meters of the "Momentan" type. The difficulties arising in the measurement of γ-rays are discussed and the Sievert condenser dosemeter and other high sensitivity instruments described. J. E. R.

4895. Biological Effects and Therapeutic Possibilities of Neutrons. G. L. Locher. *Am. J. of Roentgenology and Radium Therapy*, 36. *pp.* 1–13, *July*, 1936.—Neutrons can now be obtained in sufficiently abundant intensities to foreshadow biological and therapeutic applications. The nature and behaviour of neutrons are discussed generally and their biological effects considered. These effects may result by direct collision and by ejection of H particles. A further effect may arise by selective absorption and the possibility is discussed in respect to the introduction of substances into an organism which will bring about high selective absorption. In many respects the neutron acts as a trigger mechanism, causing nuclear atomic transformations, but the phenomenon is not a simple trigger mechanism, as absorption and retention of the neutrons occurs. Many physical problems remain to be solved, such as development, simple measuring apparatus, scattering and the energy relations during absorption. Fields of application include the possibility of destroying or weakening cancerous cells and pathological bacteria. Present methods of producing neutrons by bombardment of Be with α-rays from Ra or Rn, bombardment of elements with high velocity deuterons generated by high-voltage machines are considered with brief descriptions of high-voltage electrostatic generators, high-voltage cascade transformers, series-parallel condensor generators, successive acceleration of ions passing through hollow cylinders, the "cyclotron" of Lawrence, and Beams apparatus. With a view to possible future medical applications, protection of the operators is discussed and such protection must be greater than when dealing with Ra radiations. Finally, possible methods of measurement and filtration at present available are given, although the future may require much modification in respect to practical use. With Lawrence's "cyclotron," results of experiments of blood changes induced in rats suggest that fast neutrons may be ten times as efficacious as hard X-rays and

Zircle and Aebersold's experiments on wheat seedlings suggest that 1 r. of fast neutrons may be as effective as 20 r. of X-rays in this particular respect. B. J. L.

4896. Dosage System for Cylindrical Distributions of Radium. R. Paterson, H. M. Parker and F. W. Spiers. *Brit. J. of Radiology*, 9. *pp.* 487–508, *Aug.*, 1936.—Clinical aspects of the use of cylindrical Ra applicators are discussed by the first author from the medical aspect with respect to the use for conditions of the neck, leg and penis. The physical basis of the dosage system for such applications is then discussed by the second author and the theoretical distribution for a continuous cylindrical applicator is mathematically derived and represented by a series of graphs by the third author. B. J. L.

OSCILLATIONS.

4897. Voltage-Current Curves Obtained with an Electrolytic Cell and Electric Oscillations. T. Terada. *Kyoto Coll. Sci., Mem.* 19. *pp.* 57–64, *Jan.*, 1936. *In English.*—Voltage-current curves are found between a Pt plate electrode in dilute HCl and a point electrode at its surface. The curves obey Ohm's law for low voltage but at higher voltages the effects are different according as the point or plate is positive. The differences are explained by the point electrode becoming hot and giving off thermions, which in the case of its being surrounded by H_2, are accelerated, but when the gas is Cl_2 are retarded. Other effects are noted for varied procedures. It is shown, that with chokes, such an electrolytic cell can supply the fluctuating potential necessary to excite oscillations in a condenser-induction arm. H. M. B.

***4898. Operation of Grid-Controlled Gas-Discharge Tubes for Production of Oscillations. P. Drewell.** *Zeits. f. techn. Physik*, 17. 8. *pp.* 249–262, 1936.—Examination of the discharge of the condenser used in conjunction with a gas-discharge tube having an incandescent kathode for the generation of electric oscillations shows that the tube is abnormally loaded under such conditions. The high peak values of discharge current that occur can only be explained by assuming that powerful ionisation takes place within the gas chamber, the thermal emission from the kathode accounting for only a small fraction of the current flowing. The mechanism is considered whereby extinction of the tube takes place after the discharge of the condenser and in this connection important differences in the behaviour of A- and H-filled tubes are pointed out. It is also shown that owing to the greater mobility of the H-ion the oscillations produced by the H-filled tube can reach much higher frequencies than can those produced by the A-filled tube. The longer life of the kathode in the H-filled tube is another of its advantages. C. C.

***4899. Strobotron. H. Klemperer.** *Zeits. f. techn. Physik*, 17. 8. *pp.* 285–286, 1936.—A small grid-controlled gas-discharge tube, having a cold kathode activated by means of a cæsium compound, has been developed by K. J. Germershausen and is notable for the high peak values of currents obtainable—in the neighbourhood of 200–300 A. It is particularly adapted for the generation of oscillations by the periodic discharge of a condenser joined across kathode and anode, and on account of the intensity of the light emitted, especially when Ne-filled. The tube is most useful for stroboscopic work ; for this reason it has been given the name Strobotron by its inventor. C. C.

***4900. Thermionic D.C. Amplification. P. A. Macdonald.** *Physics*, 7. *pp*. 265–294, *Aug*., 1936.—The principles and practical applications of thermionic valves are discussed at some length in relation to the amplification of direct currents. AUTHOR.

4901. Transition from Electric Waves to Dark Heat Waves. K. F. Lindman. *Zeits. f. techn. Physik*, 17. 8. *pp*. 269–275, 1936.—Experiments show that it is possible to pass over from electromagnetic waves to dark heat waves of approximately the same frequency, thus proving that heat waves (like light waves) are electromagnetic. Using Hertzian oscillators [see Abstract 2993 (1935)], gratings, spheres and mirrors of special form and material, wave-lengths of a few cm. can be isolated. The waves from Hertzian oscillators are found to heat a metal plate and a thermopile on which they impinge. The origin of these effects is discussed and the conclusion is drawn that they are components of the energy of the electromagnetic spectrum of the source. Comments are made upon the results of Nichols and Tear. H. M. B.

4902. Variation of Group-Velocity of Radio Waves with Region of Earth Traversed. H. T. Stetson. *Terr. Mag*. 41. *pp*. 287–297, *Sept*., 1936.—International comparisons of time-signals on 17 kc. have indicated variations in the velocity of propagation [see *Am. Geophys. Union, Trans*., *pp*. 158–160, 1934]. An inverse relationship was suggested between the velocity over a path and the distance of the path from the magnetic pole. The present paper contains an analysis of transmission times over a 5½-year period. On the Rugby-Annapolis route, the velocity was for long periods in the neighbourhood of 1/2 the velocity of light c; at one time it fell to under 2/5, and then for 10 months rose fairly steadily, the result calculated showing just over c. On the Bordeaux-Rugby route the velocity variations were similar in extent, though changing more slowly. On the Bordeaux-Annapolis route the velocity varied less (being consistently around 2/3 c) except on two occasions when it appeared to exceed c considerably. The 1926 world-wide longitude results are also analysed. A curve given shows the velocity falling off rapidly with decrease of the horizontal component of the earth's field H (around 0·25 C.G.S. unit); for the second half of the curve the fall of velocity is less rapid (down to 2/3 c, at H about 0·1). At the same time the angle of dip varies, increasing over a range of approximately 60° to 78°. The present data are not precise enough to distinguish between an effect which may be geographic and one which may be geomagnetic as well. Closer proximity between observatory and transmitting station is desirable for higher precision. World-wide time-signal comparisons will assist this study. R. M.

4903. Variations of the Terrestrial Magnetic Field at the Level of the Ionosphere. I. Ranzi. *N. Cimento*, 13. *pp*. 197–204, *May*, 1936.—Reference is made to some observations concerning the correlation between certain variations of phase of the echoes due to magnetic birefringence. Such correlation is foreseen from the theory of magneto-ionic refraction of the radio waves. Observations in the ionosphere seem to prove that the intensity of the terrestrial magnetic field undergoes, at the level of the ionised region F_2, variations considerably greater than those observed at the earth's surface. J. J. S.

4904. Vertical Movements of the Air in the Upper Atmosphere. L. Harang. *Terr. Mag*. 41. *pp*. 143–160, *June*, 1936.—The paper is divided into two sections the first of which briefly reviews the evidences of vertical movements of the air from determination of auroral heights, particular reference being made to the work of Størmer. The second section deals with evidences of vertical movements of air-masses in the upper atmosphere indicated by radio methods. After reference to Appleton's work the author goes on to give a number of results obtained at Tromsö and discusses the effect of these and other observers' work on the general problem. F. S. B.

4905. Characteristics of the Upper Region of the Ionosphere. L. V. Berkner, H. W. Wells, and S. L. Seaton. *Terr. Mag.* 41. *pp.* 173–184, *June*, 1936.—The Carnegie Institution of Washington has collected data over a period of one to six years of the critical penetration frequency and minimum virtual height of the F_2 region in the form of monthly averages of noon values at Washington, D.C., Huancayo, Peru, and Watheroo, Australia. These values have similar characteristics in both hemispheres reaching a maximum from Nov. to Feb. and a minimum from May to August. The hypothesis of the thermal expansion of the upper atmosphere which has been suggested by certain investigators to account for the effects observed in the northern hemisphere alone will not explain these critical frequency phenomena observed in both hemispheres simultaneously. At Washington and Watheroo the noon minimum virtual heights change inversely with the minimum noon zenith angle of the sun, while at Huancayo they change directly with this angle. This reversal in character in equatorial regions is considered and it is suggested that these effects may be explained by a new hypothesis of thermal movement of the upper atmosphere, considering the forces imposed upon the motions of the ions in the earth's magnetic field. F. S. B.

4906. Experimental Investigations of Very Long Waves Reflected from the Ionosphere. J. E. Best, J. A. Ratcliffe and M. V. Wilkes. *Roy. Soc., Proc.* 156*A*. *pp.* 614–633, *Sept.* 1, 1936.—Two separate experimental investigations of the wave returned at steep incidence from the ionosphere using a wave-length of 18,800 m. are described. In the first experiments the Hollingworth method of plotting the stationary wave system at the ground was used, under such conditions that a determination of the equivalent height of reflection and of the reflection coefficient could be made in the course of a single day or night. There was a marked change in equivalent reflection height in passing from day to night. On a September day the equivalent height was about 74 km., and the reflection coefficient about 0·25; on a November night the corresponding quantities were about 90 km. and 0·5. In the second experiments sunset and sunrise variations were observed at a fixed point, 90 km. from the transmitter, by using an aerial system arranged so as to be relatively insensitive to the very strong ground wave. These results led to the conclusion that, in winter, the wave was approximately circularly polarised with a left-handed sense, and that the equivalent reflection height increased by about 12 km. from day to night. The relation of these results to those of previous workers is discussed, and certain theoretical conclusions are deduced. AUTHORS.

4907. Comparison of Data on the Ionosphere, Sunspots and Terrestrial Magnetism. E. B. Judson. *Bureau of Standards, J. of Research*, 17. *pp.* 825–830, *Sept.*, 1936.—Ionosphere data of the National Bureau of Standards from 1930 to 1935 are compared with data on the earth's magnetic field intensity and sunspot numbers. Seasonal variations of F_2 critical frequency and virtual height are compared with sunspot numbers and magnetic activity. Correlation of annual averages of the ionosphere critical frequencies with sunspot numbers is shown. Variations of midnight F_2 critical frequencies are compared with variations of sunspot numbers and magnetic activity. AUTHOR.

4908. Oscillations in Systems with Non-Linear Reactance. R. V. L. Hartley. *Bell System Techn. J.* 15. *pp.* 424–440, *July*, 1936.—A theoretical study is presented of the properties of a condenser, one plate of which is free to vibrate, when it is included in a circuit containing a generator, the frequency of which is higher than the resonant frequency of the plate and related thereto. It is shown that the plate may be maintained in oscillation at a frequency at or near its mechanical resonance, at the expense of the energy supplied by the generator, provided certain conditions are satisfied. The most favourable condition is one in which the plate is resonant at the frequency of its vibration and the electric circuit is resonant at that of the generator, and at the difference between the generator and plate frequencies, and is anti-resonant at their sum. Under these conditions the generator voltage must exceed a threshold value determined by the impedances and frequencies. This threshold voltage increases as the conditions become less favourable. Expressions are given for the values of the oscillations as functions of the voltage when the threshold is exceeded. When the sum frequency is absent, the energies dissipated at the plate and difference frequencies are in the ratio of the two frequencies. The oscillations described represent a special case of a class of similar oscillations, all of which depend on the presence of a non-linear reactance. Another special case is a molecular model capable of reproducing the main features of the Raman effect. [See following Abstract.] AUTHOR.

4909. Oscillations in an Electromechanical System. L. W. Hussey and L. R. Wrathall. *Bell System Techn. J.* 15. *pp.* 441–445, *July*, 1936.—Experimental results are given of an oscillating electromechanical system in which, under a single-frequency impressed e.m.f., mechanical vibrations are sustained at a frequency near the resonant frequency of the mechanical system and electrical oscillations at the difference between the frequency of the mechanical vibration and that of the impressed force. The system is the one studied analytically by R. V. L. Hartley [see preceding Abstract]. Its performance conforms to the principal operating features predicted in his analysis. AUTHORS.

PHOTOELECTRICITY.

4910. Peculiar Surface Photoelectric Effect. J. M. Kuschnir. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 588–602, 1936. *In German.*—An illuminated photo-cell with a Ag-Ag_2O-Cs_2O-Cs kathode is subjected to a magnetic field, perpendicular to the electric field between the electrodes, sufficiently strong to cause the emitted photoelectrons to return to the kathode. On removal of the magnetic field the photo-current is about 1½ times the normal, but it falls off steadily to the normal value. The variation of the effect with the duration of the magnetic field and with the wave-length of the incident light is studied. The effect is considered to be due to the presence of the semi-conducting layer, which hinders the passage of the returned electrons back to the metal, and these electrons are then re-liberated on the removal of the magnetic field. D. H. F.

4911. Fatigue of Oxygen-Cæsium Photo-Kathodes. P. W. Timofejew and N. S. Kondorskaja. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 683–691, 1936. *In German.*—The progress of the fatigue of these kathodes is investigated under different conditions of illumination (intensity and wave-length), voltage and temperature (room-temperature and temperature of liquid air). It is concluded that the fatigue is due to a decrease in the free Cs on the surface of the kathode. The decrease occurs because the Cs atoms become positive ions under the influence of the light and tend to diffuse into the interior of the kathodes. The irreversible fatigue which occurs only at room-temperature is due to the reaction of the Cs with the Ag_2O film under the action of light. D. H. F.

4912. External Photoelectric Effect of Alkali Halides Coloured by Kathode Rays. E. Asmus. *Ann. d. Physik,* 26. 8. *pp.* 723–739, *Aug.,* 1936.—Powdered NaCl, KCl, LiCl and LiBr are coloured by bombardment with kathode rays and the associated external photoelectric effect is investigated, using visible light. From a variety of experiments, including successive periods of illumination with different coloured filters in the path of the incident light, it is concluded that the photoelectrons are not derived directly from the colour centres, but are due to a new excited state which is set up under the influence of the light absorbed by the centres. For irradiation with a given wave-length the photoelectric current is proportional to the number of excited colour centres. L. A. W.

4913. Photoconductivity of Cu_2O Crystals. N. J. Barbaumow and R. G. Jensch. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 551–562, 1936. *In German.*—The photoconductivity in Cu_2O crystals under simultaneous illumination by two beams of different wave-lengths is investigated, particularly as regards variations in direction and intensity of the light. The results are discussed theoretically. D. H. F.

4914. Photoconductivity in Crystals. A. L. Hughes. *Rev. Modern Physics,* 8. *pp.* 294–315, *July,* 1936.—This paper is a review of existing experimental and theoretical knowledge of the electrical conductivity which is imparted to certain insulating crystals when suitably illuminated. D. H. F.

4915. Photo-Electromagnetic Effects in Semiconductors. E. Lifshitz. *Phys. Zeits. d. Sowjetunion,* 9. 6. *pp.* 641–654, 1936. *In English.*—Previously the e.m.f. in a circuit containing a semiconductor illuminated from one side was calculated by the author and L. Landau. Similarly the case of a semiconductor in a magnetic field is dealt with in this paper. First the distribution function and the e.m.f. for a semiconductor with conducting electrons only are calculated, and next a discussion is given of the same effect in a semiconductor which contains conducting " holes " as well as conducting electrons. J. J. S.

4916. Mechanism of Becquerel Effect of Organic Substances. Cécile Stora. *Comptes Rendus,* 202. *pp.* 2152–2154, *June* 29, 1936.—This paper further discusses experimental results already published [see Abstracts 2446 and 3907 (1936)] concerning the Becquerel effect with coloured organic materials mounted on metallic electrodes. D. H. F.

See also Abstracts **4431, 4816.**

PIEZOELECTRICITY.

4917. Quartz Oscillators with Zero Thermal Coefficient of Frequency. I. Koga. *Onde Élec.* 15. *pp.* 457–468, *July, and pp.* 498–507, *Aug.,* 1936.—Summary of the author's theoretical and experimental researches on quartz oscillators with negligible thermal coefficient of frequency [see Abstract 2452 (1936)]. For short waves plates having their faces parallel to the electric axis and the normal to the faces inclined at 55° or at 138° to the optic axis give zero thermal coefficient. For long waves zero thermal coefficient can be obtained with plates cut in the same way as above, except that the inclination of the normal to the optic axis must have other values, also determined by the author. Quartz oscillator mountings are described in which fine adjustment of frequency is effected by varying the air-gap. P. V.

4918. Optical Investigation of the Strain in Quartz Rods Piezoelectrically Excited into Flexural Vibrations. K. Eichhorn. *Zeits. f. techn. Physik*, 17. 8. *pp.* 276–279, 1936.—The strain in a quartz rod vibrating in its fundamental flexural mode, and in another vibrating in its first overtone flexural mode, in the direction of the optic axis, is examined by means of a stroboscopic Kerr cell illumination. The same a.c. supply is used for the piezoelectric excitation and for the illumination, whilst a phase shifter interposed between the supply and the Kerr cell makes possible examination of the strain for any desired phase of the vibrating quartz. Photographs giving the distribution of strain in the YZ plane are reproduced, and it is shown that the tension is proportional to the distance from the neutral axis. P. V.

4919. Elastic Vibration in a Piezoelectric Crystal of Rochelle Salt. G. Michailow. *Techn. Phys., U.S.S.R.* 3. 7. *pp.* 652–661, 1936. *In English.*—Plates of Rochelle salt cut with their edges parallel to the crystallographic axes were piezoelectrically excited into vibration, and the relation between the frequency and the dimensions was observed. To a first approximation the frequency depends only on the dimension parallel to the direction of propagation, but it is also influenced by the other dimensions owing to " coupling " effects. From the experimental results the values of the elastic coefficients and elastic moduli are calculated. The values found differ by 3 % to 25 % from those determined by statical methods by Mandell. This divergence is due to the complicated nature of the vibrations of Rochelle salt crystals. P. V.

4920. Temperature Coefficients of Shear and Longitudinal Modes of Vibration. H. Osterberg. *Rev. Sci. Instruments*, 7. *pp.* 339–341, *Sept.*, 1936.—Expressions for the temperature coefficients of longitudinal and shear modes of vibrations are derived and discussed. The conditions for zero temperature coefficients are stated. In the case of the shear modes of vibration, the orientations which permit zero temperature coefficients are a function of the overtones and of the crystal dimensions. Hence, no unique angle of orientation independent of the dimensions of the specimen exists. The theory is applied to the grinding of quartz plates which shall regularly have temperature coefficients lower than those obtained by previous methods of orienting these plates. AUTHOR.

THERMIONICS.

4921. Electron Affinity of Bromine Atoms from Space-Charge Effects. G. Glockler and M. Calvin. *J. Chem. Phys.* 4. *pp.* 492–493, *Aug.*, 1936.—The electron affinity of Br atoms is determined from the space-charge effects of a hot W filament in Br_2 vapour and is found to be 88 ± 3·4 k.cal. [See also Abstract 910 (1936).] AUTHORS.

4922. Electron Field Emission and Contact E.M.F. for Liquid Mercury. D. H. Moore. *Phys. Rev.* 50. *pp.* 344–347, *Aug.* 15, 1936.—

The relation between contact e.m.f. and the impulsive potential necessary to initiate a vacuum spark has been studied for a liquid Hg kathode. The magnitude and time of application of the impulsive potential were determined by a kathode-ray oscillograph so that possible distortion of the Hg surface produced by the electric field could be evaluated. For impure Hg no definite relation could be found. However, for carefully distilled Hg the relation between the work function and breakdown field was in qualitative but not in quantitative agreement with theory. AUTHOR.

4923. Effect of Temperature, Degree of Thoriation and Breakdown on Field Currents from Tungsten and Thoriated Tungsten. A. J. Ahearn. *Phys. Rev.* 50. *pp.* 238–253, *Aug.* 1, 1936.—Electron field currents from thoriated W, with different degrees of thoriation, were found to be independent of temperature. The characteristic field current curve was found to be independent of the degree of thoriation of a thoriated W filament. An electrical breakdown occurs with thoriated tungsten and pure tungsten kathodes, which increases the current by factors from 10×10^3 to 10×10^6. With pure tungsten no change in the thermionic activity of the kathode results from the breakdown; with thoriated W the thermionic emission is increased. Heat treatment at about 1300° K following breakdown further increases the field currents from thoriated W but not from pure W. If the temperature is raised to 2600° K the increased field currents disappear. The value of the breakdown field is independent of the temperature and the degree of thoriation. The application of the usual breakdown voltage with the filament as anode produces none of the normal effects of breakdown. The evidence favours the following conclusions: the electric field rather than the voltage applied to the kathode is the domiating factor involving breakdown; the anode has no effect on breakdown; when the shielding of the glass surfaces is adequate, the breakdown is primarily determined by conditions at the kathode. The highest electric field that could be applied to a kathode without breakdown was about $4{\cdot}7 \times 10^6$ V/cm. F. C. C.

4924. Production of Slow Rays of K Ions. H. Poeverlein. *Ann. d. Physik,* 27. 1. *pp.* 92–96, *Sept.,* 1936.—Apparatus is described which furnishes rays of slow K ions of high intensity and uniform velocity for a given accelerating potential. The ions are produced by the ionisation of K atoms at the face of a Pt or W foil at a temperature of over 800° C. The K atoms are supplied by bombardment of the foil with rays of K atoms. Curves are given showing the velocity distributions for accelerating potentials of 10 V and 116 V. A. W.

4925. Filament Sources of Positive Ions. J. P. Blewett and E. J. Jones. *Phys. Rev.* 50. *pp.* 464–468, *Sept.* 1, 1936.—Efficient filament sources of ions of the alkali metals have been produced by heating synthetic alkali Al silicates. Studies of emission of the Li sources as a function of composition reveal that the silicate 1 Li_2O : 1 Al_2O_3 : 2 SiO_2 is the most satisfactory ion emitter. Similar sources of the other alkalies prove stable and copious. Ions of Mg, Ca, Sr, Ba, Al, Ga, In, Ti, V, Mn, Y, and Ce, are emitted when the oxide of the metal in question is heated to a white heat on a W filament. The O_2^- peak observed by Barton has been checked. In the case of Al, negative ions of mass 27—presumably Al^-—were observed. AUTHORS.

THERMOELECTRICITY.

See Abstract 4833.